E83-10262

HS 236-0019-161

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SEPT 1982

THEMATIC MAPPER

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Prepared for
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland 20771

CONTRACT NAS 5-24200

FLIGHT MODEL
PRESHIPMENT REVIEW
DATA PACKAGE
VOLUME III - SYSTEM DATA
PART B

Article IV -3A

HUGHES

HUGHES AIRCRAFT COMPANY
SPACE AND COMMUNICATIONS GROUP

HS 236-0019-1679

THEMATIC MAPPER

Prepared for
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland 20771
CONTRACT NAS 5-24200

SEPT 1982

FLIGHT MODEL PRESHIPMENT REVIEW DATA PACKAGE
VOLUME III - SYSTEM DATA
PART A

Article IV - 3A

HUGHES
HUGHES AIRCRAFT COMPANY
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Hughes Ref No. D4528

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THEMATIC MAPPER
FLIGHT MODEL
PRESHIPMENT REVIEW
VOLUME III
SYSTEM DATA

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THEMATIC MAPPER

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3.0 SYSTEMS INTEGRATION AND TEST

Data contained in this section is segregated by test performed on the Flight Model Thematic Mapper.

Each section contains lists of references to all pertinent documents relating to the test, including test specifications and plans; and copies of the test results from which the summary charts of Volume I were derived.

3.1 VIBRATION TEST & ACOUSTICAL NOISE TEST

Test Summary: HS236-8110 S.G. Oxley
HS236-8119 R.A. Amador

Test Specification: TP32015-609 TM Vibration Test Procedure
TP32015-623 TM Acoustics Test Procedure

Reference Documentation: HS236-2154 Revision to Specification
GSFC 400.8-D-201, 9 June 1981

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SANTA BARBARA RESEARCH CENTER
A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO: J. L. Engel
CC: Distribution
DATE: 16 August 1982
REF: HS236-8110

SUBJECT: Flight Vibration Test - Quick Look
FROM: S. G. Oxley

BLDG. S1 MAIL STA. D306
EXT. 74338

Summary

Vibration of the flight model Thematic Mapper caused no functional degradation. However, linear variable differential transformer (LVDT) data indicate that LVDT 3 moved 0.8 mils during the Z-axis vibration. Presently scheduled thermal vacuum tests will determine if this is an indication of actual inchworm motion.

Telescope baseplate temperature telemetry failed prior to vibration and the odd preamplifier temperature telemetry was not tested due to a test cable failure. All other telemetry was functional at all times.

Introduction

The flight model Thematic Mapper was vibrated along each of three orthogonal axes on 14 and 15 August 1982. A system readiness test (SRT) was conducted before vibration and after each axis of vibration. This memo summarizes the results of these SRT's.

Relays

Prior to each vibration, the thermal shutdown relay was enabled and the cooler door latch relay was closed; all other relays were open. After each vibration it was verified that no relays had changed state.

Commands

All commands, both normal and redundant, executed properly at all times.

Telemetry

The telescope baseplate temperature telemetry failed prior to vibration. The odd ambient preamplifier temperature channel was open in a test cable and, therefore, not tested. All other telemetry was functional before and after each vibration.

Multiplexer

The multiplexer functioned properly.

Scan Mirror

The scan mirror functioned properly. Time length data are given in Tables 1 and 2. The small changes in midscan nonlinearity, Table 3, are not a problem.

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Scan Line Corrector

The scan line corrector was functional as indicated by scan line corrector drive current telemetry as observed on a chart recorder.

Shutter

The calibration shutter functioned properly. Figure 1 shows a typical "before and after" calibration pulse.

Backup Shutter

The backup shutter functioned properly as indicated by phase lock and amplitude lock telemetry.

Calibration Lamps

The internal lamps and the lamp sequencer functioned properly throughout the tests.

Video Channels

All band 1 through band 4 video channels were operable before and after vibration.

Cooler Door

The cooler door drive was functional in all respects before and after vibration.

LVDT

The LVDT's functioned at all times. However, as shown in Table 4, telemetry indicates that LVDT 3 moved 0.8 mils during the Z-axis vibration. Additional, presently scheduled, tests will show if this represents actual inchworm motion.

S. G. Oxley
Systems Engineering

/lbg

TABLE I

SCAN MIRROR LINE LENGTH*, SAM MODE

FLIGHT 1

	TIME		SME	FORWARD SCAN			REVERSE SCAN		
				FIRST HALF SCAN ERROR (MSEC)	SECOND HALF SCAN ERROR (MSEC)	SCAN TIME (MSEC)	FIRST HALF SCAN ERROR (MSEC)	SECOND HALF SCAN ERROR (MSEC)	SCAN TIME (MSEC)
SBRC	4AUG82	18:58	1	130.4	-130.3	60742.9	177.0	-176.8	60742.8
				$\sigma=3.8$	$\sigma=4.7$	$\sigma=8.4$	$\sigma=4.1$	$\sigma=5.3$	$\sigma=9.2$
		19:32	2	132.9	-132.7	60742.8	176.8	-176.6	60742.8
				$\sigma=3.5$	$\sigma=4.6$	$\sigma=7.9$	$\sigma=3.9$	$\sigma=4.2$	$\sigma=7.8$
HAC PRE-VIB	13AUG.	21:07	1	129.4	-129.5	60743.0	182.8	-182.6	60742.8
				$\sigma=3.5$	$\sigma=4.3$	$\sigma=7.6$	$\sigma=4.4$	$\sigma=5.1$	$\sigma=9.3$
		21:11	2	131.1	-131.1	60743.0	181.9	-181.7	60742.8
				$\sigma=3.6$	$\sigma=4.1$	$\sigma=7.5$	$\sigma=3.9$	$\sigma=4.7$	$\sigma=8.3$
POST Y-AXIS VIB.	14AUG	14:27	1	127.7	-127.4	60742.6	178.0	-177.8	60742.8
				$\sigma=3.9$	$\sigma=4.5$	$\sigma=8.3$	$\sigma=4.2$	$\sigma=5.8$	$\sigma=9.3$
		13:36	2	129.0	-129.2	60743.2	176.6	-176.7	60743.0
				$\sigma=3.2$	$\sigma=4.2$	$\sigma=7.2$	$\sigma=4.1$	$\sigma=5.0$	$\sigma=8.9$
POST Z-AXIS VIB	14AUG	22:10	1	128.2	-128.1	60742.8	175.3	-175.2	60742.8
				$\sigma=3.4$	$\sigma=3.6$	$\sigma=6.8$	$\sigma=4.3$	$\sigma=5.2$	$\sigma=9.3$
		22:14	2	129.4	-129.3	60742.9	175.3	-175.2	60742.8
				$\sigma=3.3$	$\sigma=4.7$	$\sigma=8.3$	$\sigma=4.3$	$\sigma=5.2$	$\sigma=9.2$
POST X-AXIS VIB	15AUG	12:07	1	124.2	-124.3	60743.0	179.1	-179.1	60742.9
				$\sigma=3.5$	$\sigma=4.0$	$\sigma=7.5$	$\sigma=4.2$	$\sigma=5.4$	$\sigma=9.4$
		12:11	2	125.6	-125.5	60742.9	178.4	-178.1	60742.7
				$\sigma=4.3$	$\sigma=5.2$	$\sigma=9.3$	$\sigma=4.2$	$\sigma=5.5$	$\sigma=9.5$

* AVERAGE OF 100 SCANS

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TABLE 2
SCAN MIRROR LINE LENGTH,* BUMPER MODE
FLIGHT 1

		TIME	SME	FORWARD SCAN PERIOD, μSEC μ/σ	REVERSE SCAN PERIOD, μSEC μ/σ
SBRC	9AUG82	19:00	1	71342.7/8.8	71342.6/8.8
		19:26	2	71342.7/8.1	71342.8/10.2
HAC PRE-VIB	13AUG	21:09	1	71342.7/8.6	71342.8/8.3
		21:13	2	71343.1/9.3	71343.0/10.9
POST Y-AXIS VIB	14AUG	13:29	1	71342.6/9.3	71342.8/9.2
		13:38	2	71342.6/9.5	71342.8/10.0
POST Z-AXIS VIB	14AUG	22:12	1	71343.0/9.2	71342.9/10.3
		22:15	2	71342.6/9.4	71342.9/11.0
POST X-AXIS VIB	15AUG	12:09	1	71342.6/9.1	71342.6/10.4
		12:12	2	71342.8/8.9	71342.7/9.6

* AVERAGE OF 100 SCANS

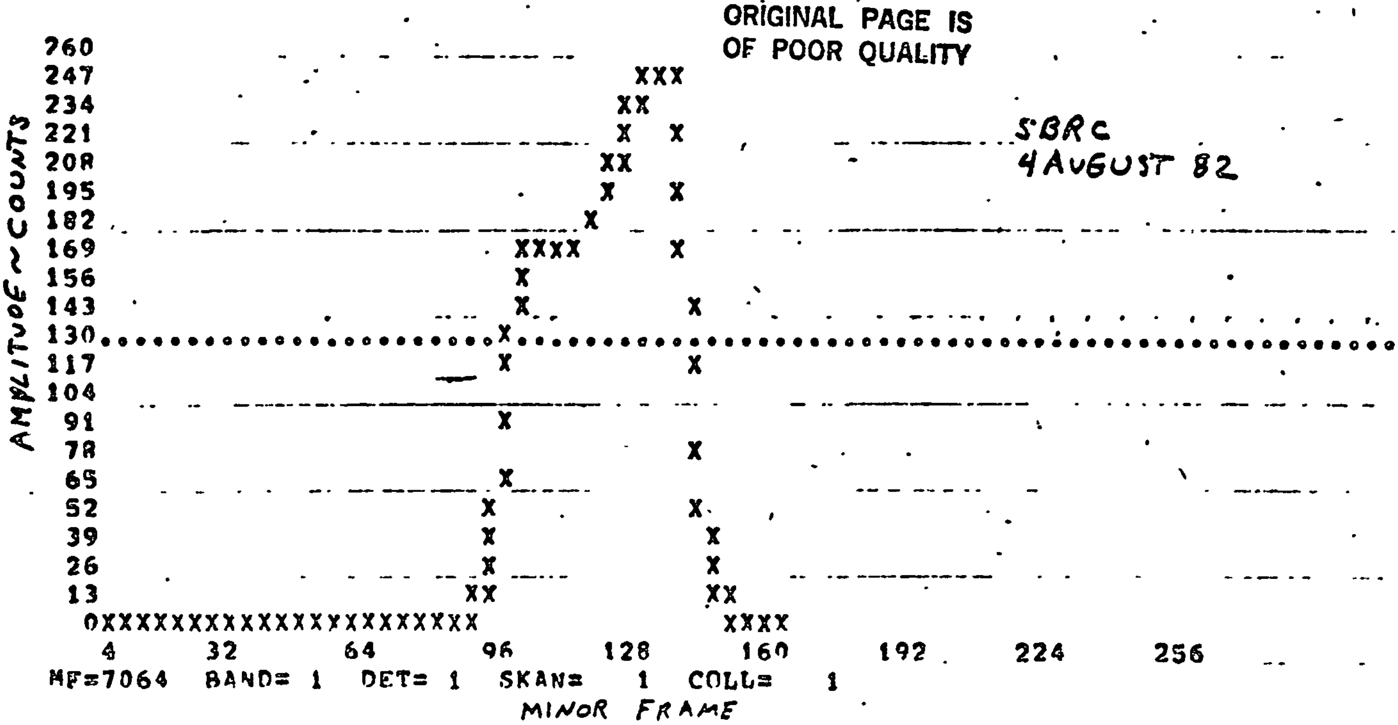
TABLE 3
MIDSCAN LINEARITY
FLIGHT-1

	TIME		NON-LINEARITY (SM μrad) FORWARD μ	σ	REVERSE μ	σ	ERROR (SM μrad) NESTED	NON-NESTED
SBRC	AUG 3	19:52	292.3	2.3	-397.3	2.3	-50	340
PRE-VIB	AUG 13	19:48	286.7	2.1	-400.6	2.4		
POST Y	AUG14	12:49	283.3	2.1	-393.7	2.4		
POST Z	AUG14	21:20	282.9	2.0	-388.2	2.4		
POST X	AUG15	12:29	275.5	1.9	-394.2	2.5	-60	335

FIGURE 1

FLIGHT MODEL CALIBRATION PULSE LOCATION

PRE-VIB / POST VIB



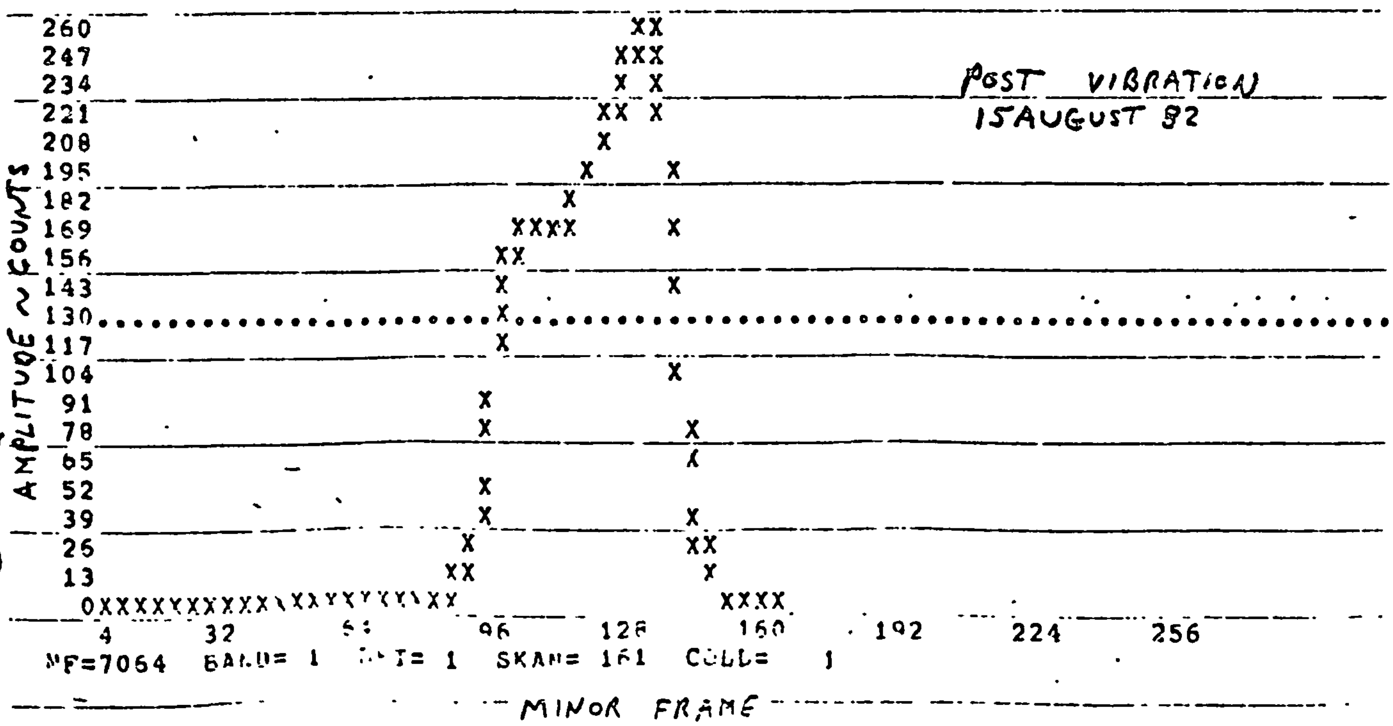


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TABLE 4
FLIGHT 1 LVDT POSITION HISTORY

	TIME	LVDT 1			LVDT 2			LVDT 3		
		INCHES	OCTAL COUNTS	DECIMAL COUNT	INCHES	OCTAL COUNTS	DECIMAL COUNTS	INCHES	OCTAL COUNTS	DECIMAL COUNTS
4AUG82	18:37	LVDT'S ON								
	18:37	-0.0038	136	94	-0.0016	160	112	-0.00138	162	114
	18:37	POWER SUPPLY 1 OFF								
(SBRC	18:38	POWER SUPPLY 1 ON								
PRE-SHIP)	18:38	-0.0037	137	95	-0.0011	164	116	-0.00162	160	112
	18.41	LVDT'S OFF								
	18:49	LVDT'S ON								
	18.49	-0.0035	140	96	-0.0017	157	111	-0.00162	160	112
	18:49	POWER SUPPLY 2 OFF								
	18:50	POWER SUPPLY 2 ON								
	18:50	-0.0037	137	95	-0.0016	160	112	-0.00162	160	112
	18.53	LVDT'S OFF								
13AUG	19:19	LVDT'S ON								
	19:19	-0.0037	137	95	-0.0014	162	114	-0.00138	162	114
	19:19	POWER SUPPLY 1 OFF								
(HAC	19:19	POWER SUPPLY 1 ON								
PRE-VIB	19:21	LVDT'S OFF								
POST-SHIP)	19:35	LVDT'S ON								
	19:35	-0.0037	137	95	-0.0014	162	114	-0.00150	161	113
	19:36	POWER SUPPLY 2 OFF								
	19:37	POWER SUPPLY 2 ON								
	19:37	-0.0037	137	95	-0.0013	163	115	-0.00150	161	113
	19:40	LVDT'S OFF								
14AUG	12:26	LVDT'S ON								
	12:26	-0.0038	136	94	-0.0019	162	114	-0.00150	161	113
	12:26	POWER SUPPLY 1 OFF								
(POST	12:27	POWER SUPPLY 1 ON								
Y-AXIS	12:27	-0.0037	137	95	-0.0014	162	114	-0.00150	161	113
VIB)	≈12:35	LVDT'S OFF								
	12:40	LVDT'S ON								
	12:40	-0.0037	137	95	-0.0015	161	113	-0.00138	162	114
	12:40	POWER SUPPLY 2 OFF								
	12:42	POWER SUPPLY 2 ON								
	12:42	-0.0035	140	96	-0.0015	161	113	-0.00138	162	114

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TABLE 4 (CONTINUED)
FLIGHT 1 LVDT POSITION HISTORY

	TIME	LVDT 1			LVDT 2			LVDT 3		
		INCHES	OCTAL COUNTS	DECIMAL COUNTS	INCHES	OCTAL COUNTS	DECIMAL COUNTS	INCHES	OCTAL COUNTS	DECIMAL COUNT
14AUG82	20:55	LVDT ON								
	20:55	-0.0035	140	96	-0.0014	162	114	-0.00066	170	120
	20:55	POWER SUPPLY 1 OFF								
	20:56	POWER SUPPLY 1 ON								
(POST	20:56	-0.0035	140	96	-0.0014	162	114	-0.00066	170	120
Z-AXIS	20:59	LVDT'S OFF								
VIB.)	21:06	LVDT'S ON								
	21:07	-0.0037	137	95	-0.0014	162	114	-0.00066	170	120
	21:07	POWER SUPPLY 2 OFF								
	21:08	POWER SUPPLY 2 ON								
	21:08	-0.0035	140	96	-0.0015	161	113	-0.00066	170	120
	21:11	LVDT'S OFF								
15AUG	11:41	LVDT'S ON								
	11:41	-0.0035	140	96	-0.0015	161	113	-0.00078	167	119
	11:41	POWER SUPPLY 1 OFF								
	11:43	POWER SUPPLY 1 ON								
	11:43	-0.0035	140	96	-0.0015	161	113	-0.00066	170	120
(POST	11:45	LVDT'S OFF								
X-AXIS	11:56	LVDT'S ON								
VIB.)	11:56	-0.0035	140	96	-0.0015	161	113	-0.00066	170	120
	11:56	POWER SUPPLY 2 OFF								
	11:57	POWER SUPPLY 2 ON								
	11:58	-0.0035	140	96	-0.0014	162	114	-0.00066	170	120
	12:00	LVDT'S OFF								

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SANTA BARBARA RESEARCH CENTER
A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO F. Phillips CC. Distribution DATE: 25 August 1982

REF: HS 236-8119

SUBJECT. TM F1 Vibration and Acoustic Test Results

FROM: R. A. Amador

BLDG. B12 MAIL STA. 28
EXT. 6251

References:
1. TP32015-623, TM Acoustic Test Procedure, 17 May 1982
2. TP32015-609, TM Vibration Test Procedure, 30 June 1982
3. HS236-2154, TM Program, Revisions to Specification GSFC 400.8-D-201, 9 June 1981
4. TM Waiver W-171, August 12, 1982

Summary

The F1 Thematic Mapper was exposed to flight acceptance level acoustic noise at TRW Systems on 18 August 1982 and flight acceptance level sine vibration on 13 August through 15 August 1982 at HAC/ES. The results of System Readiness Tests (SRTs) conducted at the conclusion of the acoustic test and at the conclusion of each axis of vibration indicated that the measured system performance parameters remained unchanged from the time the system left SBRC. All of the measured acceleration responses were equal to or less than what had been predicted by analysis and linear scaling of protoflight model test results. The F1 TM is structurally sound in all respects and suitable for spacecraft integration from a mechanical standpoint. This report documents the results of both the acoustic and sine vibration testing, the procedures for which are References 1 and 2, respectively.

Acoustic Test Discussion

The first step performed as part of the acoustic test procedure was a nitrogen gas purge with an overall sound pressure level of 122dB. The gas purge provided data points from which extrapolations to flight level acoustic responses were made. The only data recorded in the gas purge were RMS voltages within a 10 khz bandwidth which were converted to g RMS levels. The variation in 3σ acceleration response as a function of applied sound pressure level for accelerometer 4x located on the cooler door assembly is shown in Figure 1. The location of accelerometer No. 4 showed the highest dynamic response of all response locations in the full level acoustic test.

The fifteen response power spectral densities and g RMS levels recorded on the F1 TM during the 138 dB overall sound pressure exposure (-6 dB down from flight level) were such that the structural integrity of the TM could be predicted to not be adversely affected in the full

level 144 dB overall sound pressure level run. The results of the 144 dB full level run enveloped the linear extrapolations made from the -6 dB results. Specifically, the structural damping factors in the 144 dB responses were greater than what had been predicted by linear extrapolation from the -6 dB results such that the acceleration responses in the full level run were lower then the predictions.

The maximum response measured in the 144 dB overall full level run was 34.5 g 3σ peak at accelerometer No. 4x located on the cooler door assembly adjacent to the door hinge on the foot side of the TM. Figures 2 and 3 illustrate the location of the five triax accelerometers. During EM/STM cooler door/shroud penalty testing, the door response was driven to 82 g 3σ peak and the magnetic latches provided enough holding force such that the door did not open. The 34.5 g 3σ peak on the door assembly discussed above corresponds approximately to 44.5 g 3σ response of the door itself which indicates a minimum margin on the door not opening of 70%.

The Appendix contains all of the recorded -6 dB power spectral density responses as was the preliminary full level responses of all accelerometers. The final PSDs will be included in a separate document from TRW Systems to be released once the data is available and verified.

As part of the preparation for the acoustic test, deflection measurements were taken of the TM shipping container when loaded with 780 lbs (TM plus fixture). The purpose of the measurements was to assure a minimum natural frequency less than or equal to 50 hz for the TM moving as a rigid body on the shipping container. These measurements indicated a 5.6 hz natural frequency which was well below the maximum allowable. See Figure 4 for the acoustic test setup.

Vibration Testing Discussion

The sequence of vibration testing was y, z, and x axis and is defined in Table 1. Table 2 lists the locations of the response accelerometers. Four separate tests were run per axis: 1) 1/4 g RMS random burst 5-500 hz; 2) 1/4 g peak sine sweep 5-500 hz; 3) flight sine as defined in Table 3; and 4) 1/4 g RMS random burst 5-500 hz. The amplifications at the frequency of the maximum response measured for each of the in-axis accelerometers during the flight sine tests are summarized in Table 4. The measured responses are well below design levels. The lowest modes of vibration are described in Table 5 for each axis.

Raymond A. Amador
R. A. Amador

Attachments

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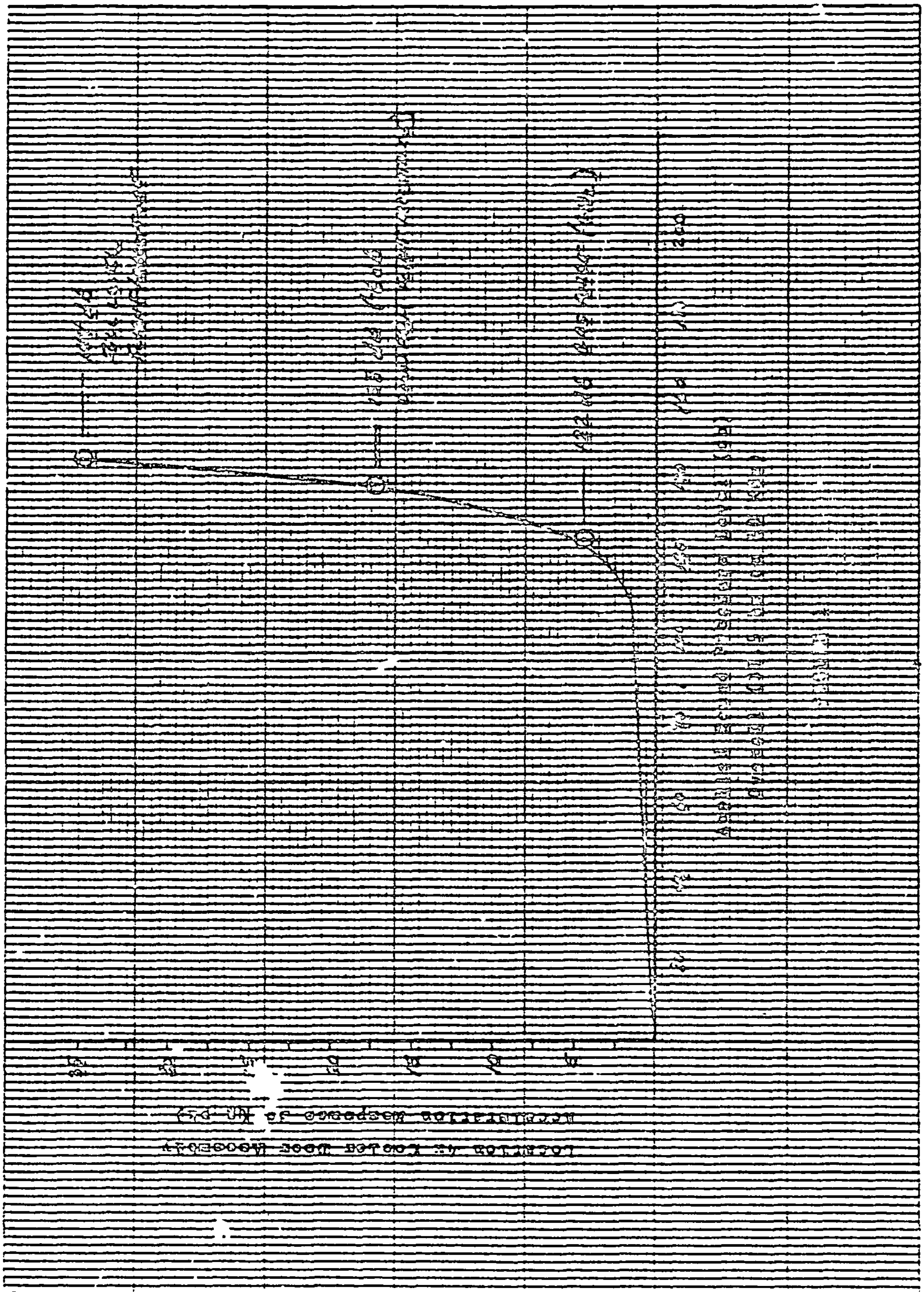

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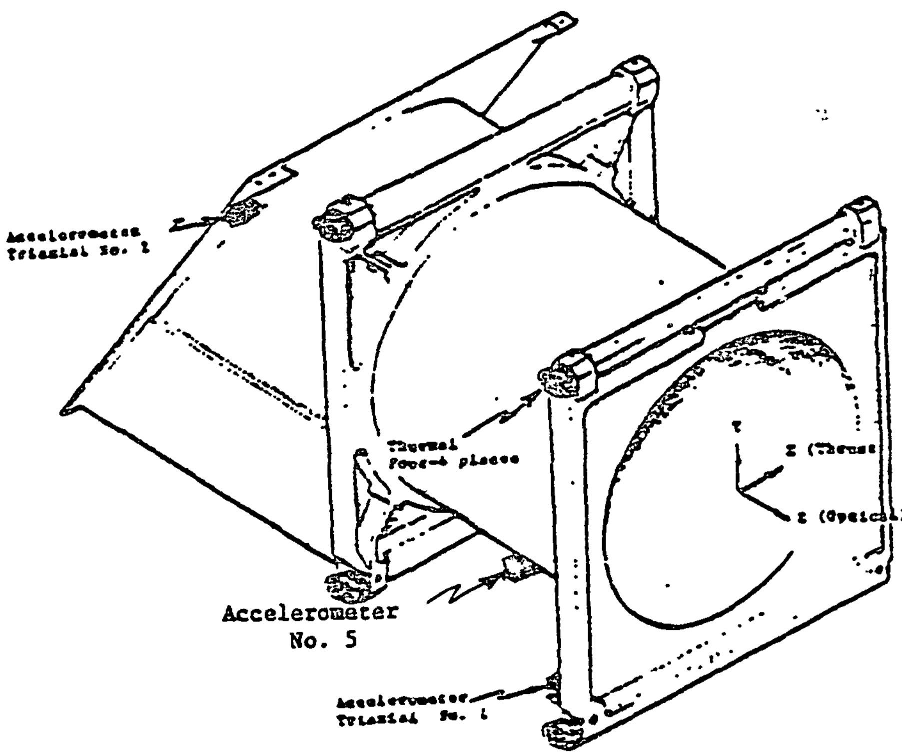

FIGURE 2. ACCELEROMETERS #1, #2, and #5 LOCATIONS

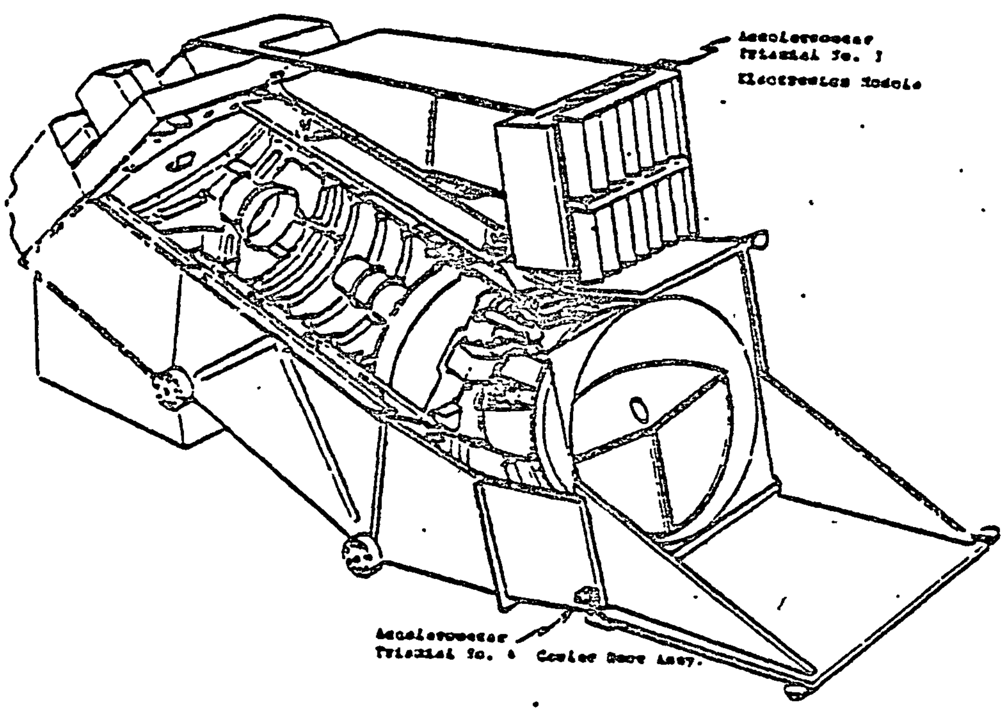

FIGURE 3. ACCELEROMETERS #3, #4 LOCATIONS

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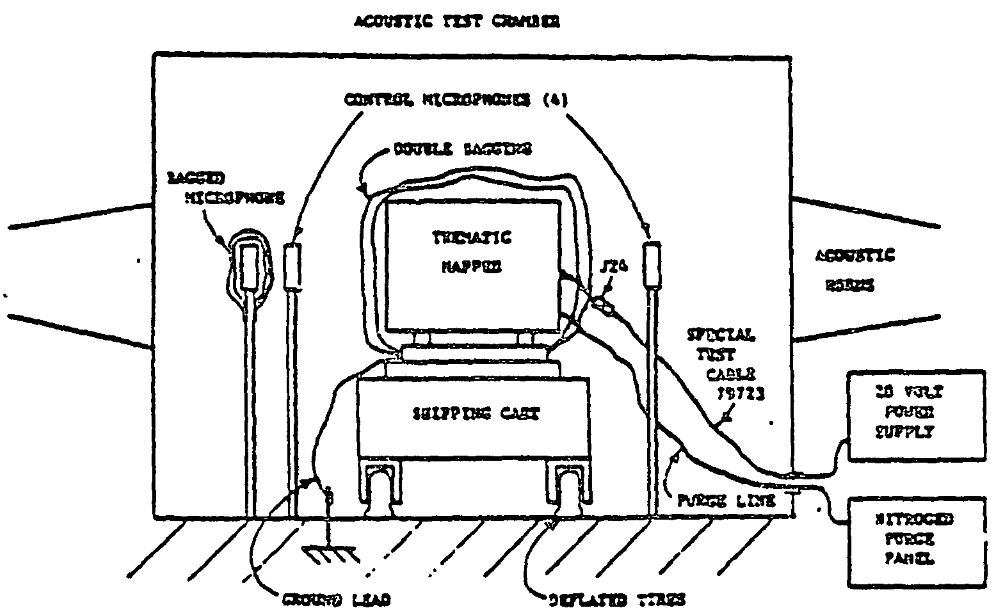

FIGURE 4. TM ACOUSTIC TEST SETUP

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TABLE 1

TEST SEQUENCE

TEST NUMBER	DESCRIPTION
110	Y Axis, random burst, 1/4 g RMS 5-500 hz 60 sec.
3110	Y Axis, low level sine, 1/4 g peak 5-500 hz
3130	Y Axis, flight sine (See Table 3)
130	Y Axis, random burst, 1/4 g RMS 5-500 hz
210	Z Axis, random burst, 1/4 g RMS 5-500 hz
3210	Z Axis, low level sine, 1/4 g peak 5-500 hz
3230	Z Axis, flight sine (See Table 3)
230	Z Axis, random burst, 1/4 g RMS 5-500 hz
010	X Axis, Random burst, 1/4 g RMS 5-500 hz
3010	X Axis, low level sine, 1/4 g peak 5-500 hz
3030	X Axis, flight sine (See Table 3)
030	X Axis, random burst, 1/4 g RMS 5-500 hz

TABLE 2

ACCELEROMETER LOCATIONS

LOCATION NO.	AXIS	LOCATION
1	XYZ	Optical Assy. main frame bulkhead
2	XYZ	SMA main frame bulkhead
3	XYZ	Electronics module
4	XYZ	Cooler Shroud/Door Interface
5	XYZ	ADS Thermal Mass

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TABLE 3

FLIGHT SINE VIBRATION

AXIS	FREQUENCY (hz)	LEVEL (g ph)
X	5 - 11.1	0.64 in D.A.
(Thrust)	11.1 - 50	4.0
	50 - 100	2.4
Y and Z	5 - 9.3	0.64 in D.A.
	9.3 - 35	2.8
	35 - 100	1.2

Sweep Rate = 4 oct/min

NOTE: See References 3 and 4.

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TABLE 4

Maximum Amplifications at Frequencies $\leq$ 100 Hz

Axis	Frequency(hz)	$\left\lvert \frac{H(j\omega)}{G(j\omega)} \right\rvert$	Location
x	92	4.0	4x
y	85	8.5	3y
z	65	7.6	3z

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TABLE 5

LOWEST MODES OF VIBRATION IN EACH AXIS $\leq$ 100 HZ

AXIS	FREQUENCY (HZ)	MODE DESCRIPTION
(Thrust) x	16; 26	Two nonlinear shaker modes: TM, fixture & armature, off of shaker flexures
y	80 - 85	Nonlinear rocking mode: TM as a rigid body off of thermal feet flexibility
z	65 - 68	Nonlinear rocking mode: TM as a rigid body of thermal feet flexibility

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APPENDIX

- Acoustic Responses
- Vibration Data All Axes

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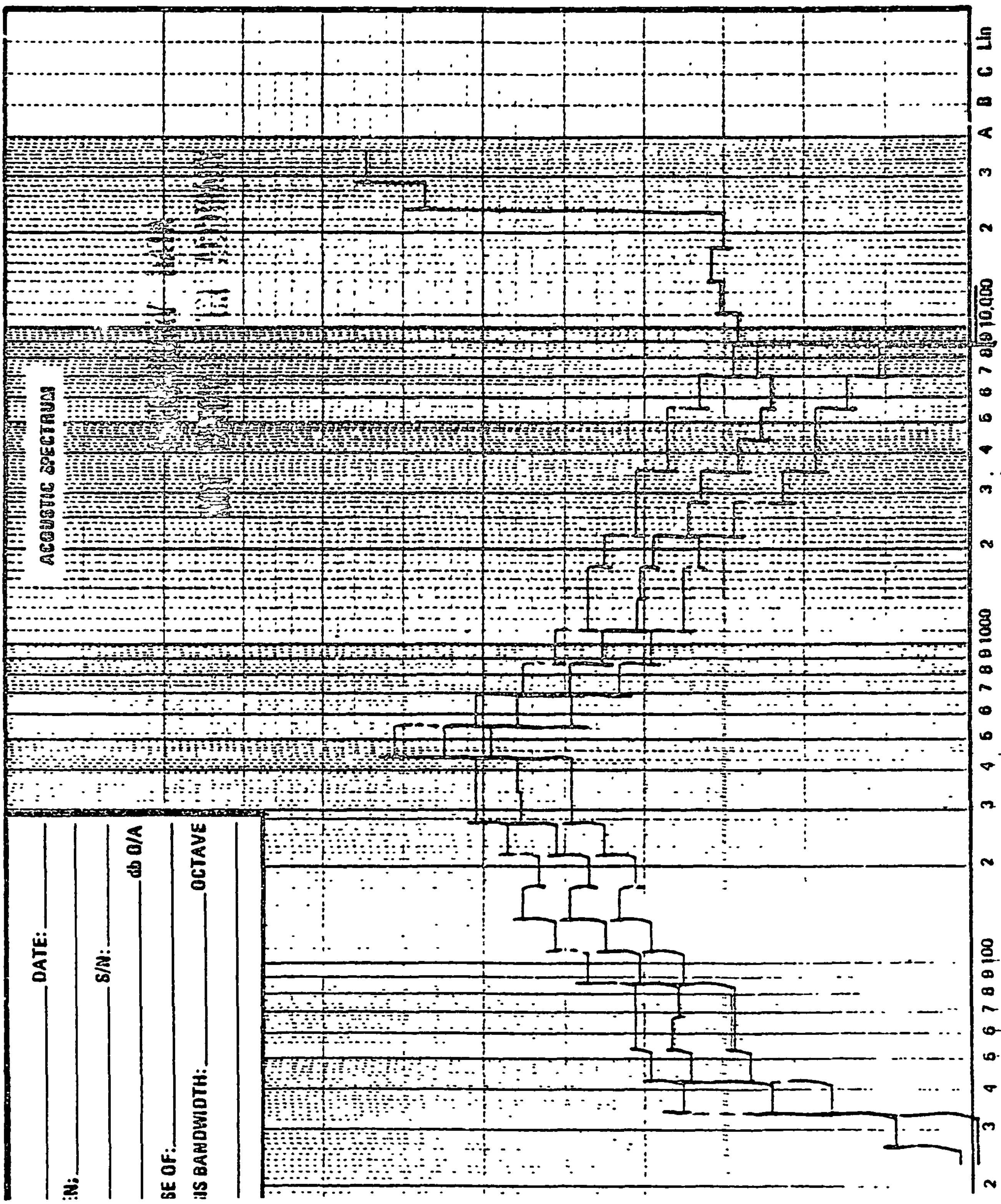
ACOUSTIC NOISE TEST DURATION 1 MINUTE

CENTER FREQ. (Hz) ONE-THIRD OCTAVE	CENTER FREQ. (Hz) OCTAVE	FLIGHT/ ACCEPTANCE ONE-THIRD OCTAVE	FLIGHT/ ACCEPTANCE OCTAVE	PROTOFLIGHT/ QUALIFICATION ONE-THIRD OCTAVE	PROTOFLIGHT/ QUALIFICATION OCTAVE	TEST TOLERANCE dB
25		119		122		
32	32	120	125	123	128	+3, -6
40		121		124		
50		123		126		
63	63	124	128	127	131	+3, -3
80		124		127		
100		127		130		
125	125	129	134	132	137	+3, -3
160		131		134		
200		130		133		
250	250	132	137	135	140	+3, -3
315		134		137		
400		134		137		
500	500	139	141.	142	144	+3, -3
630		134		137		
800		131		134		
1000	1000	129	134	132	137	+3, -3
1250		127		130		
1600		127		130		
2000	2000	126	131	129	134	+3, -3
2500		124		127		
3150		124		127		
4000	4000	122	127	125	130	+3, -6
5000		122		125		
6300		120		123		
8000	8000	118	124	121	127	+3, -6
10,000		118		121		
OVERALL			144		147	+1, -1

NOTE: Flight Acceptance Levels Applied to F1 Hardware
Sound Pressure Level (dB Ref: 20 Micro N/M^2)


ACOUSTIC SPECTRUM
DATE:
S/N:
db O/A
OCTAVE
FREQUENCY Hz
A B C Lin
10,000
1000
100

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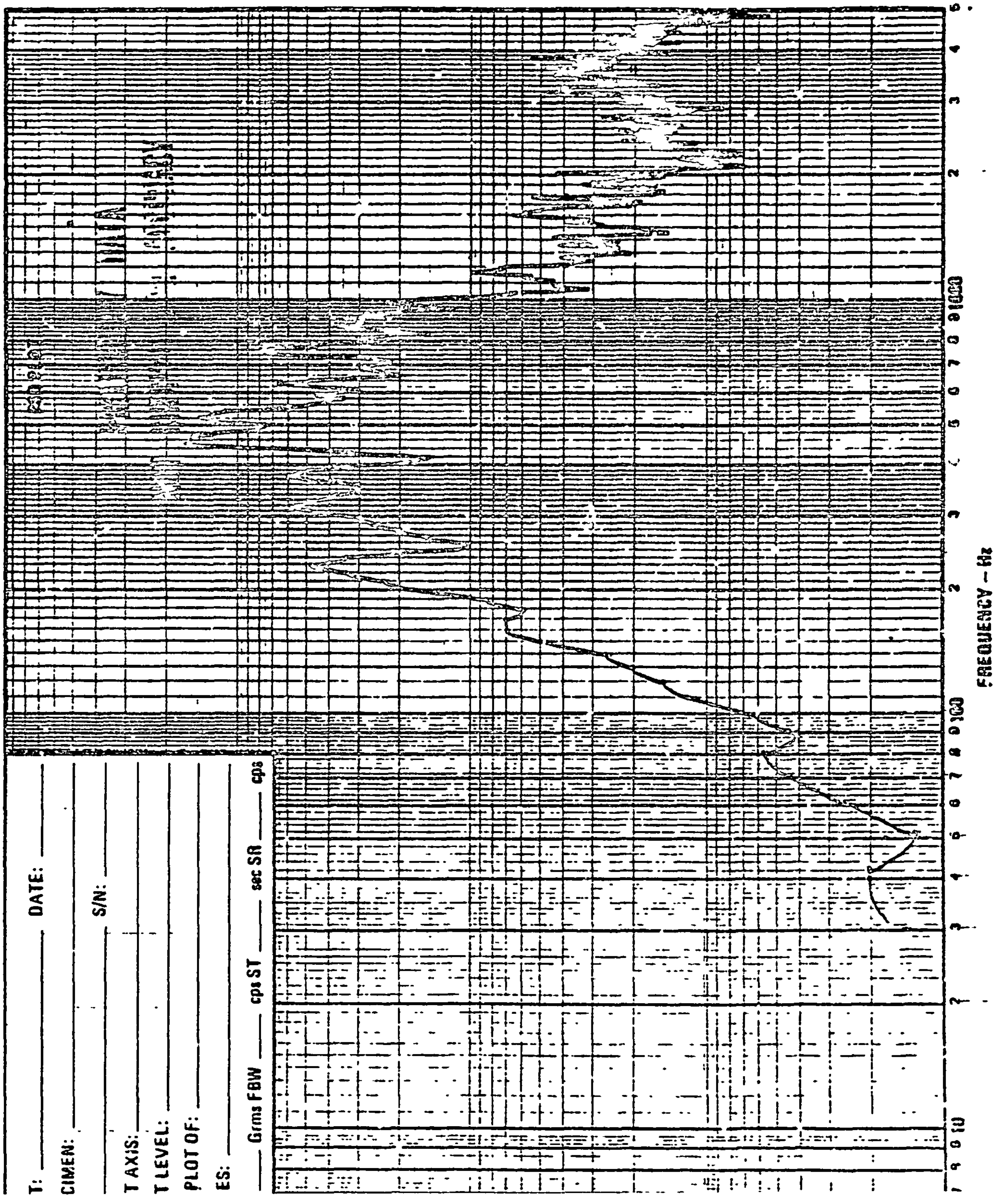

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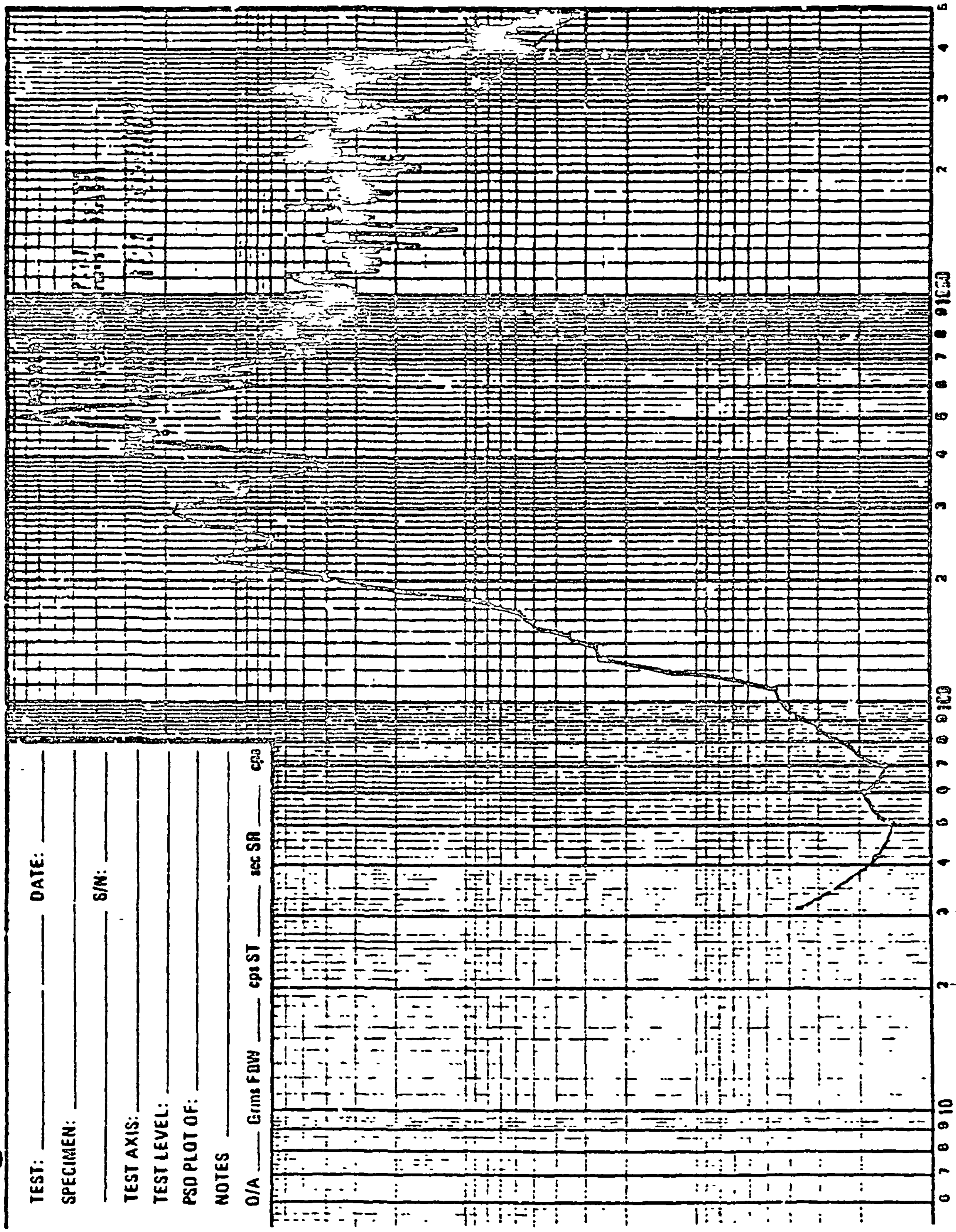

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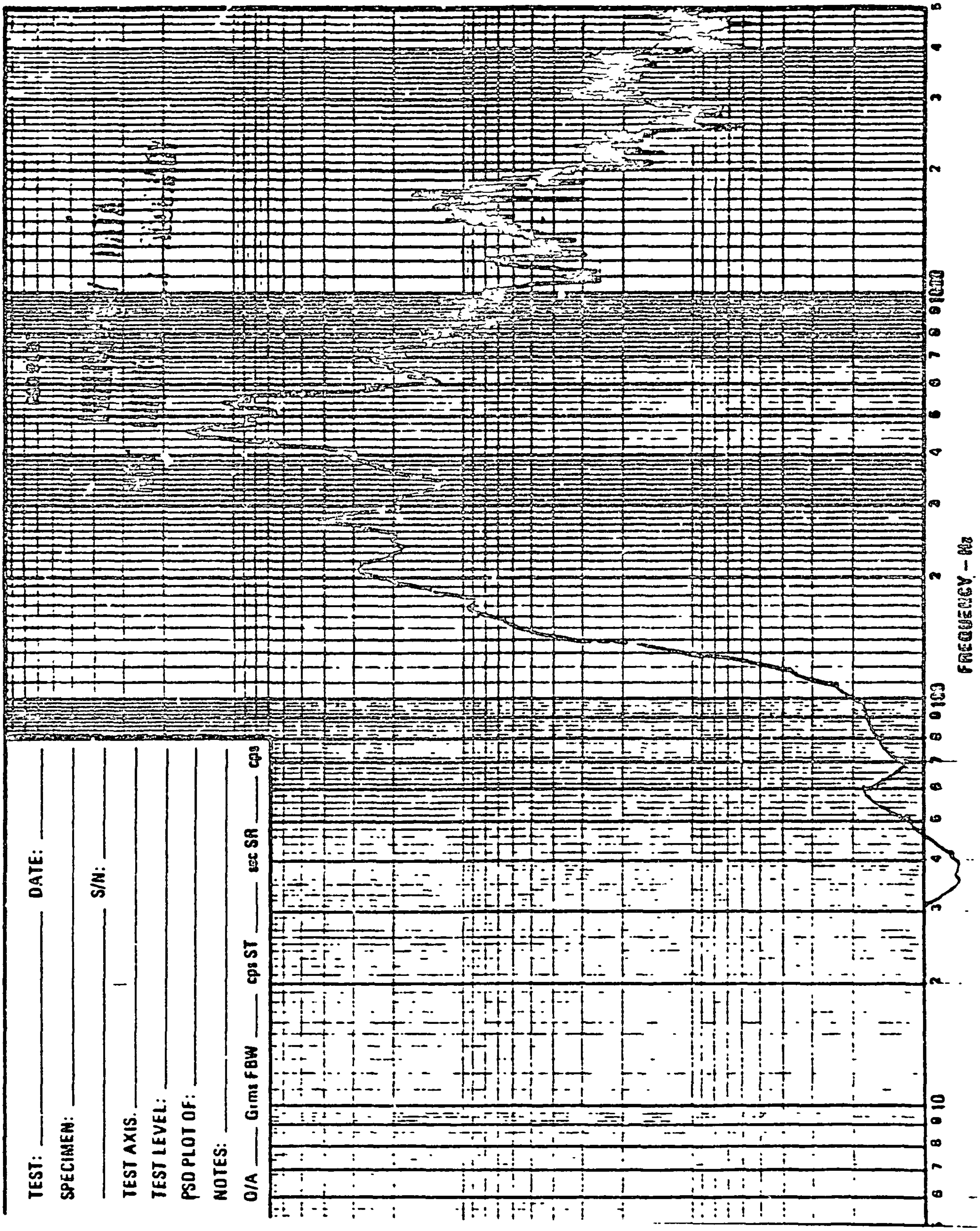

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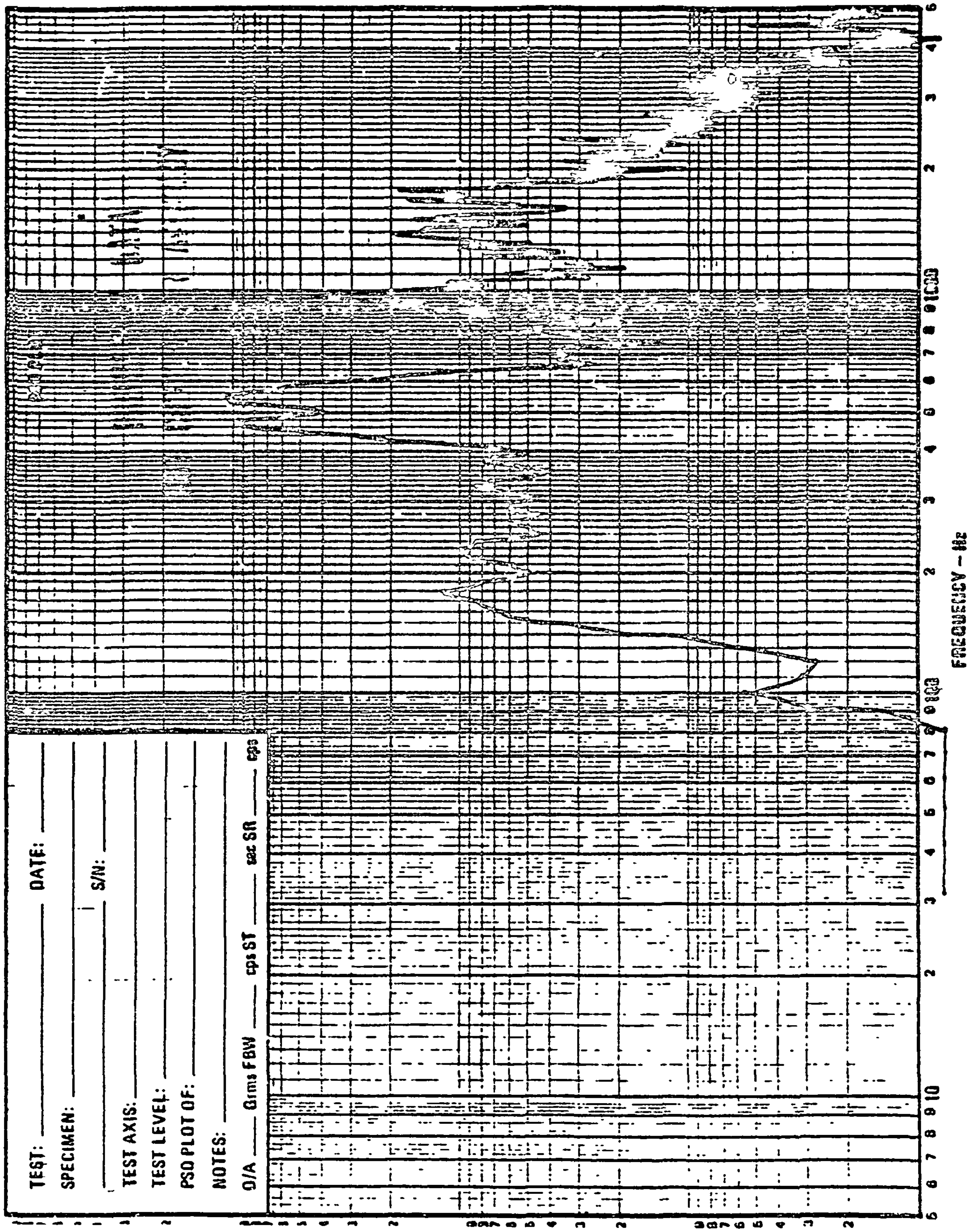

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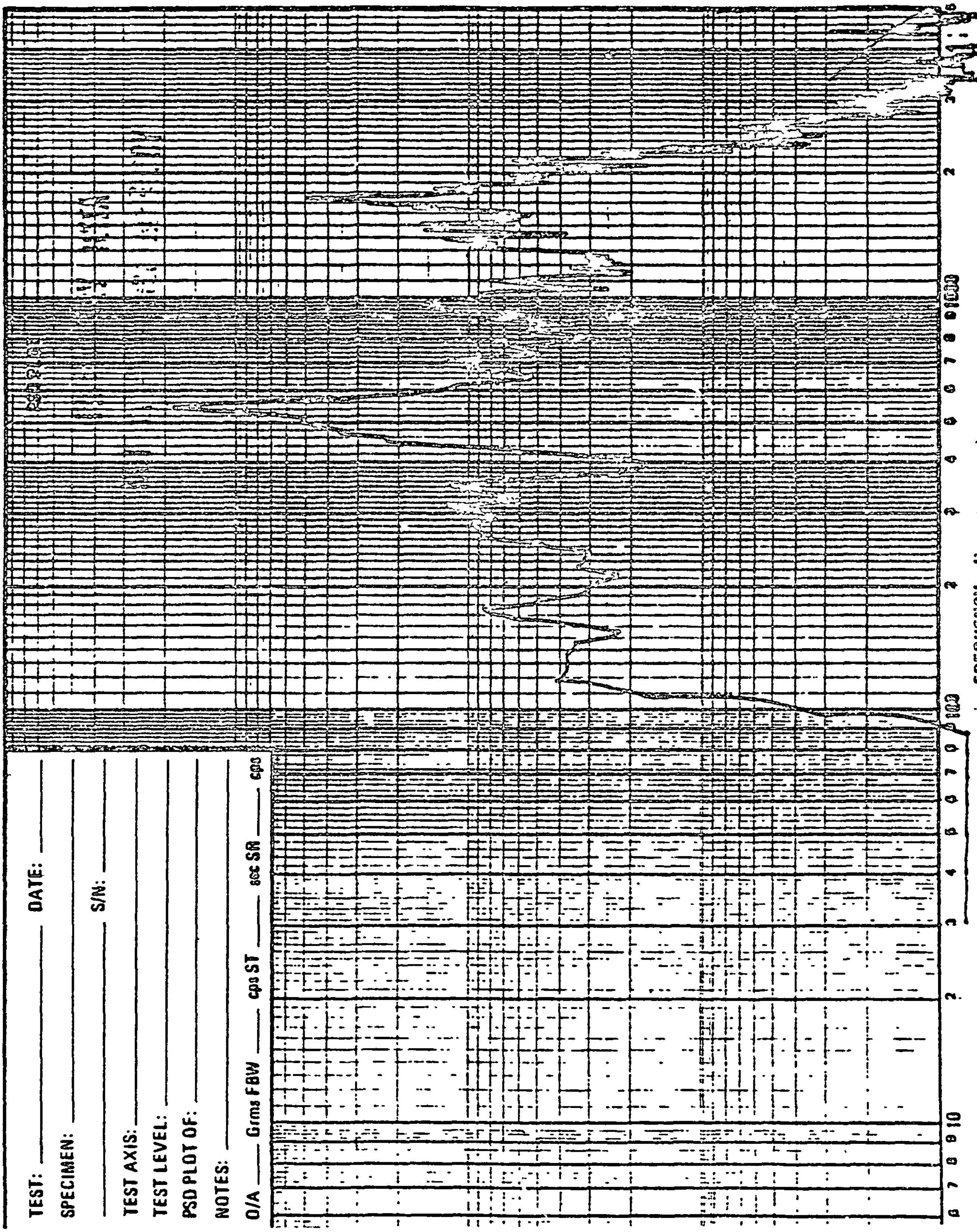

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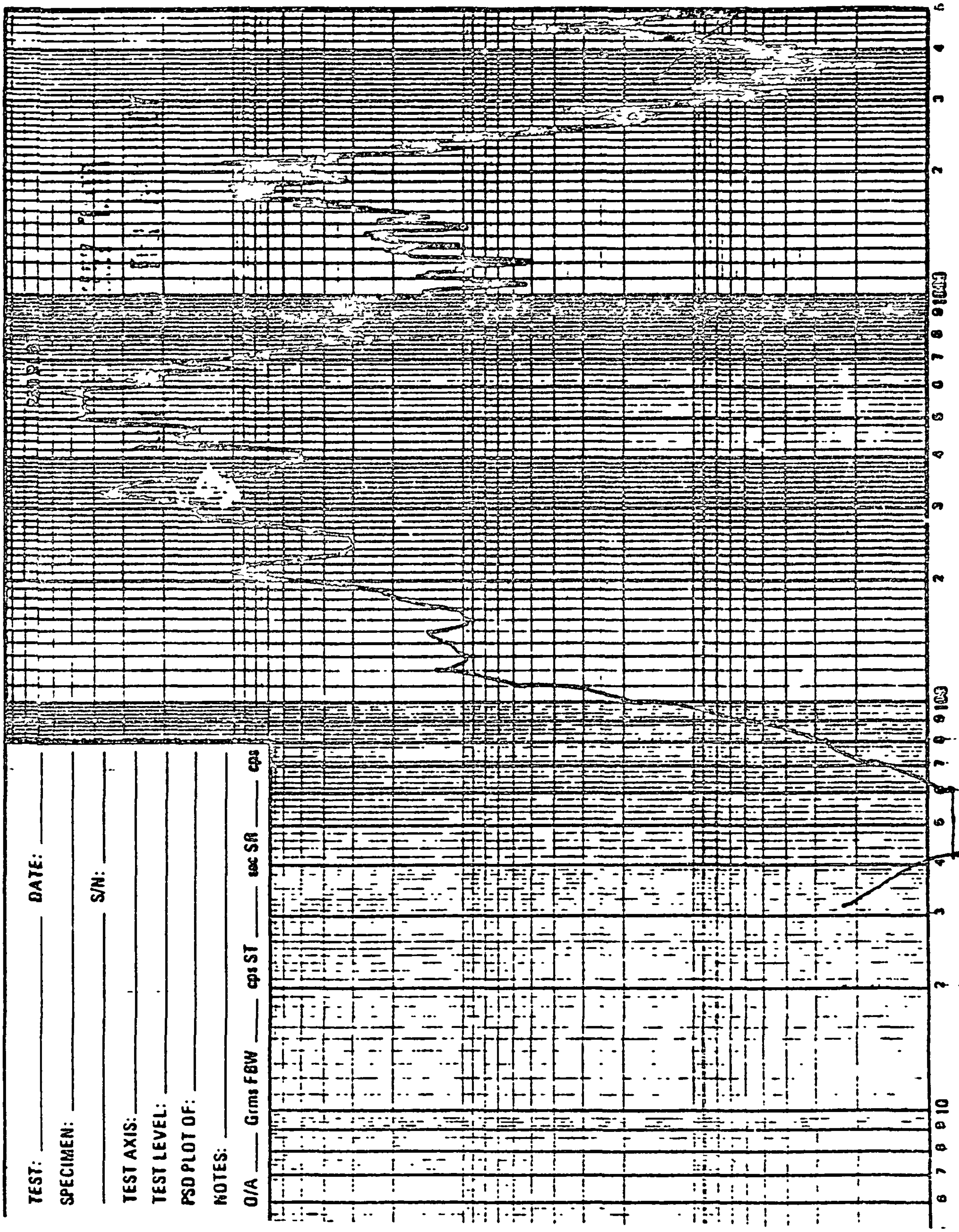

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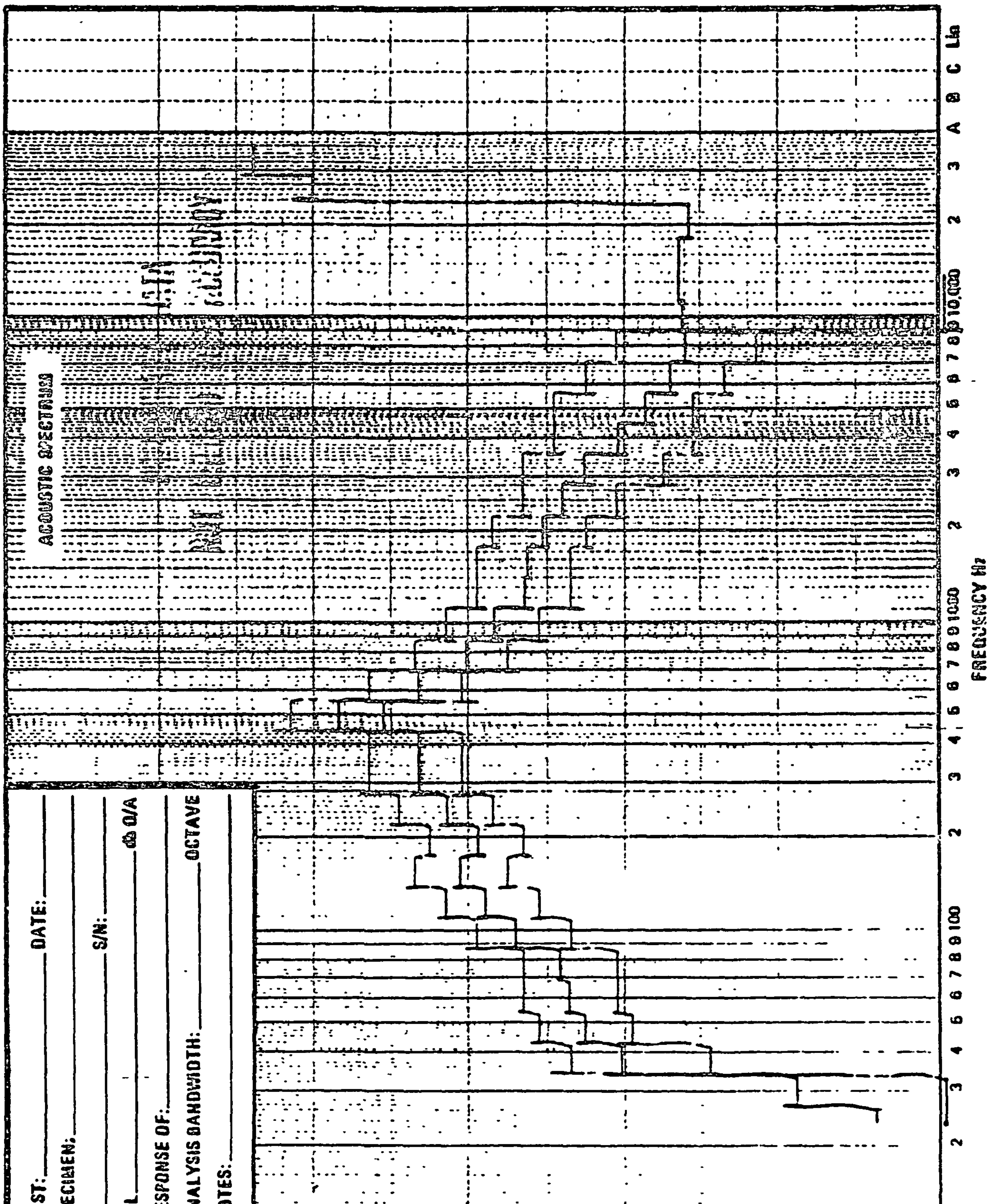

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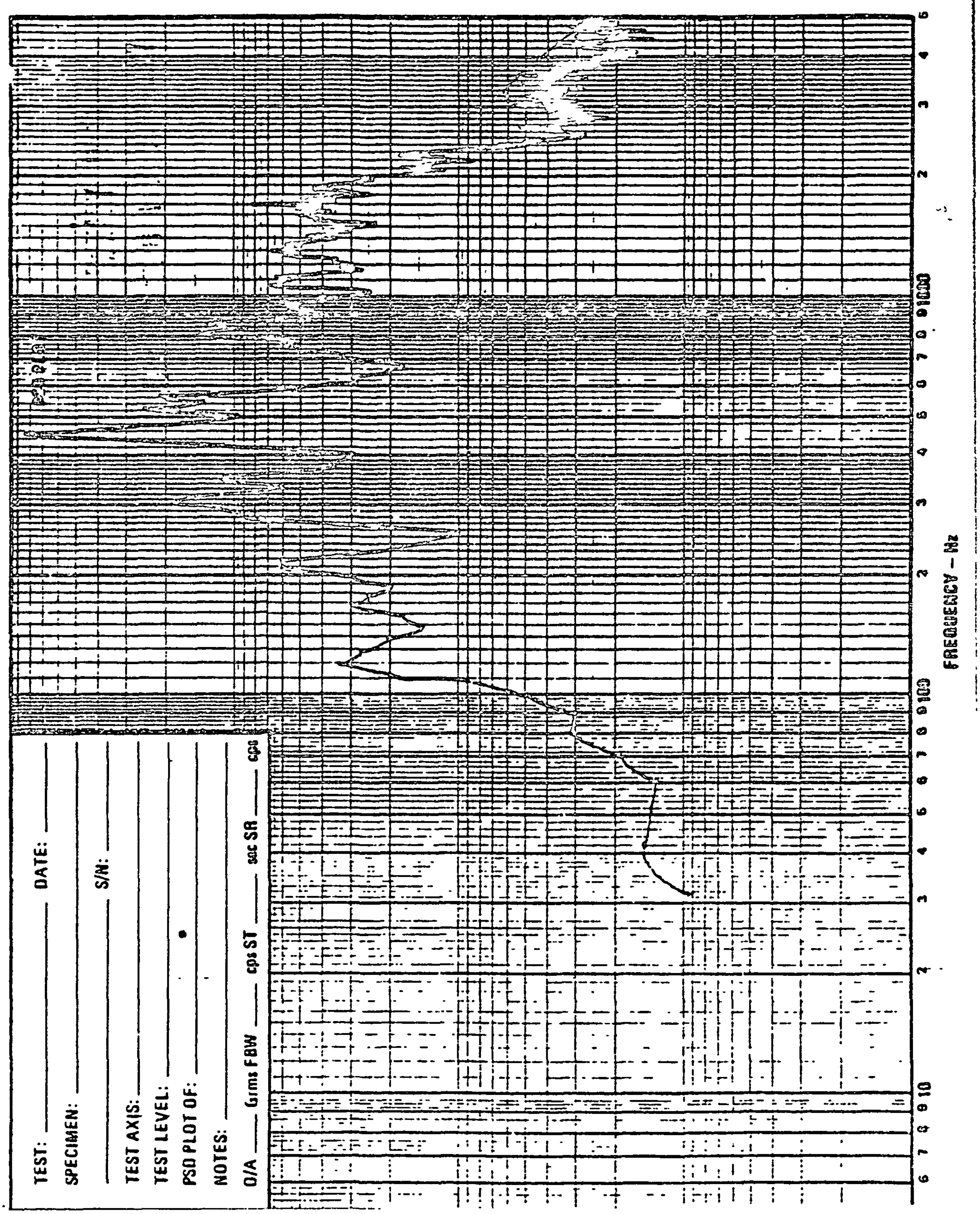

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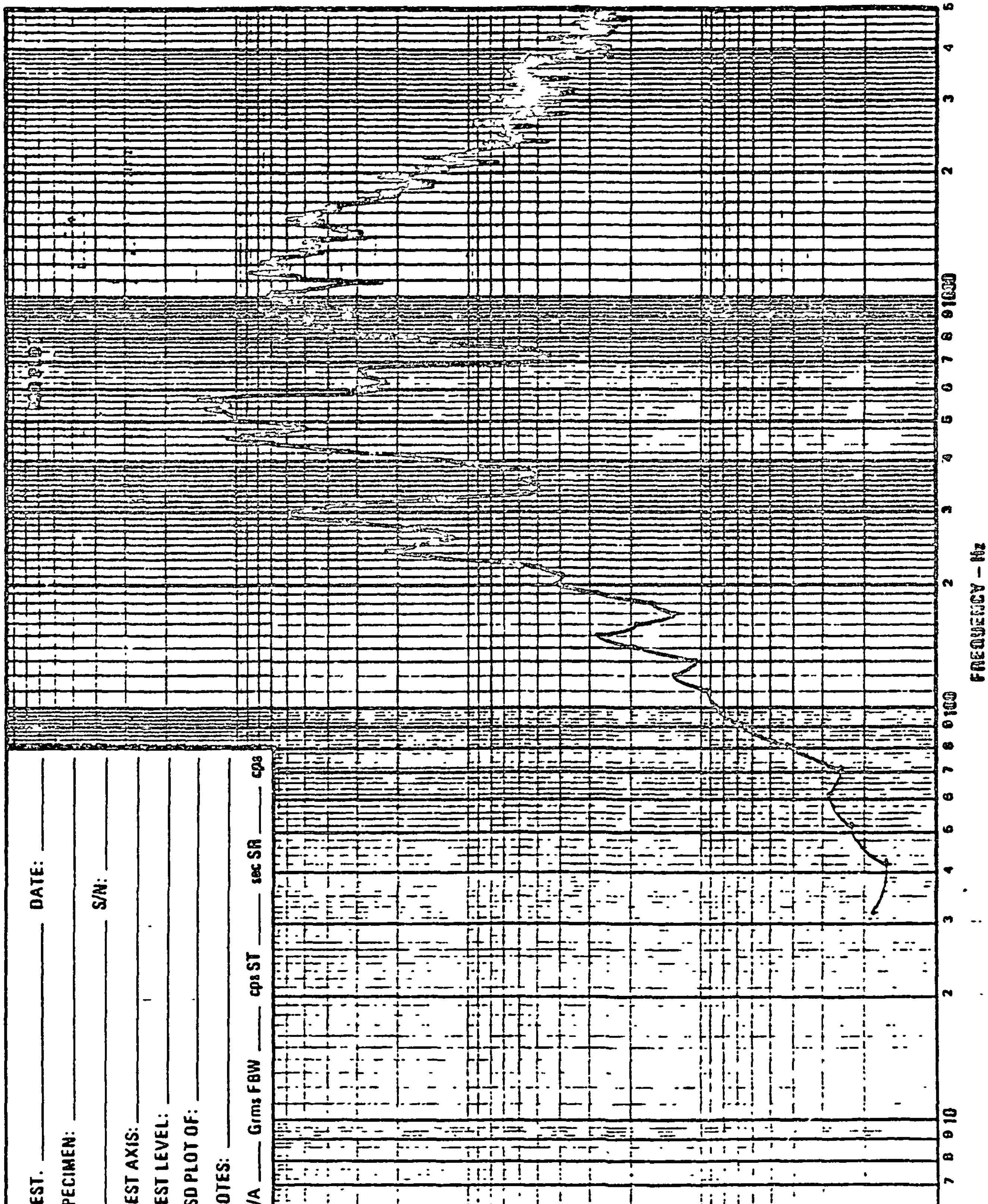

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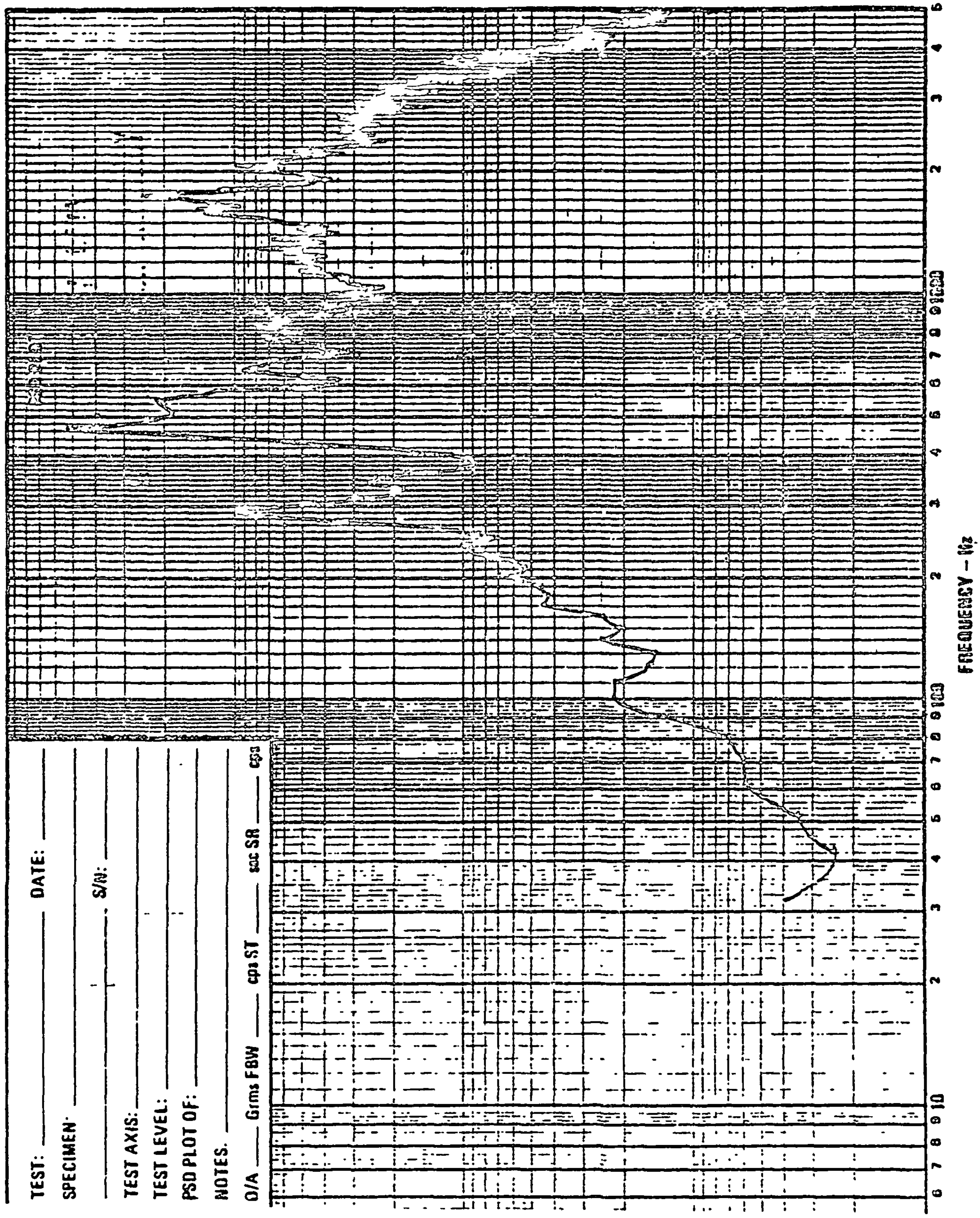

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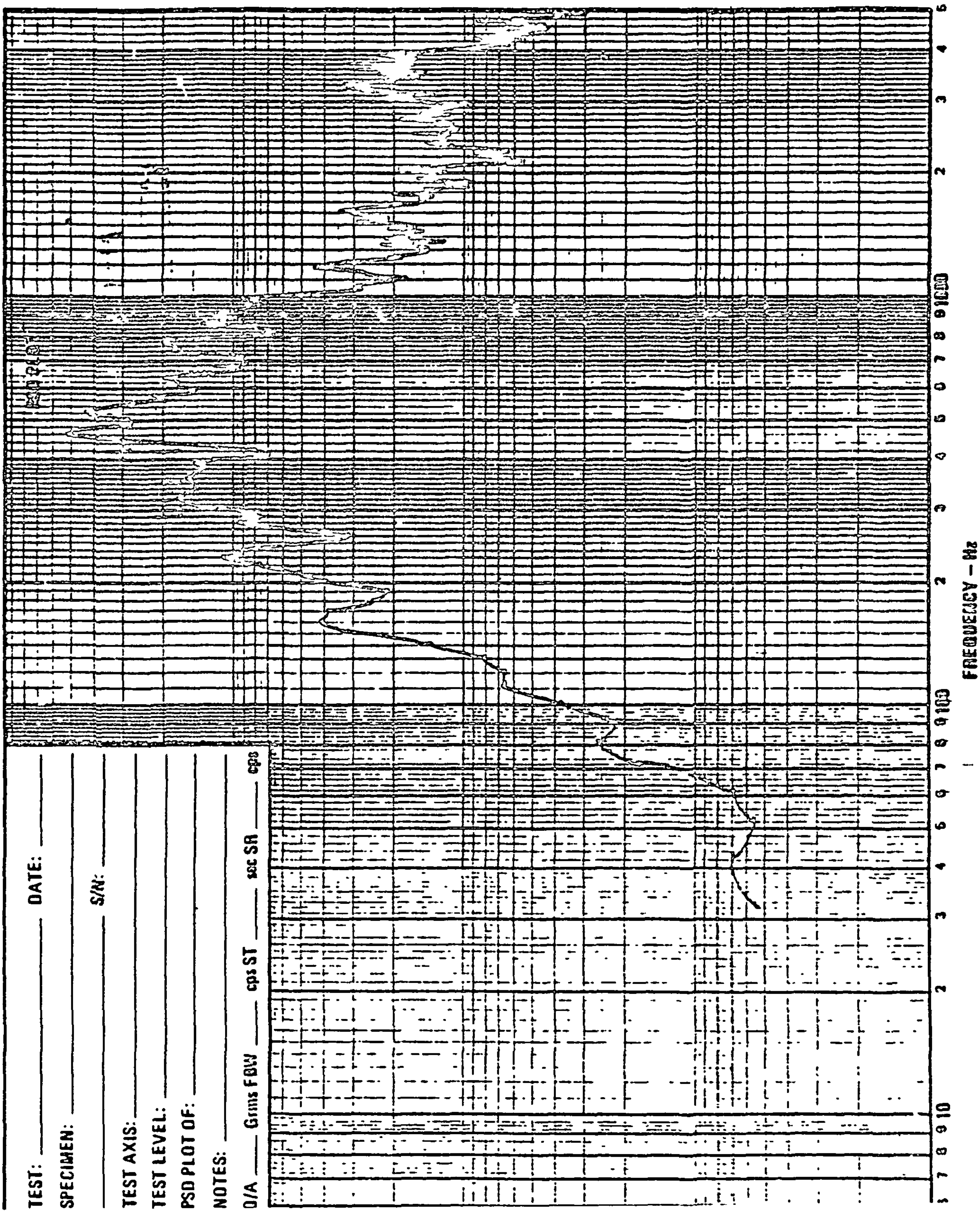

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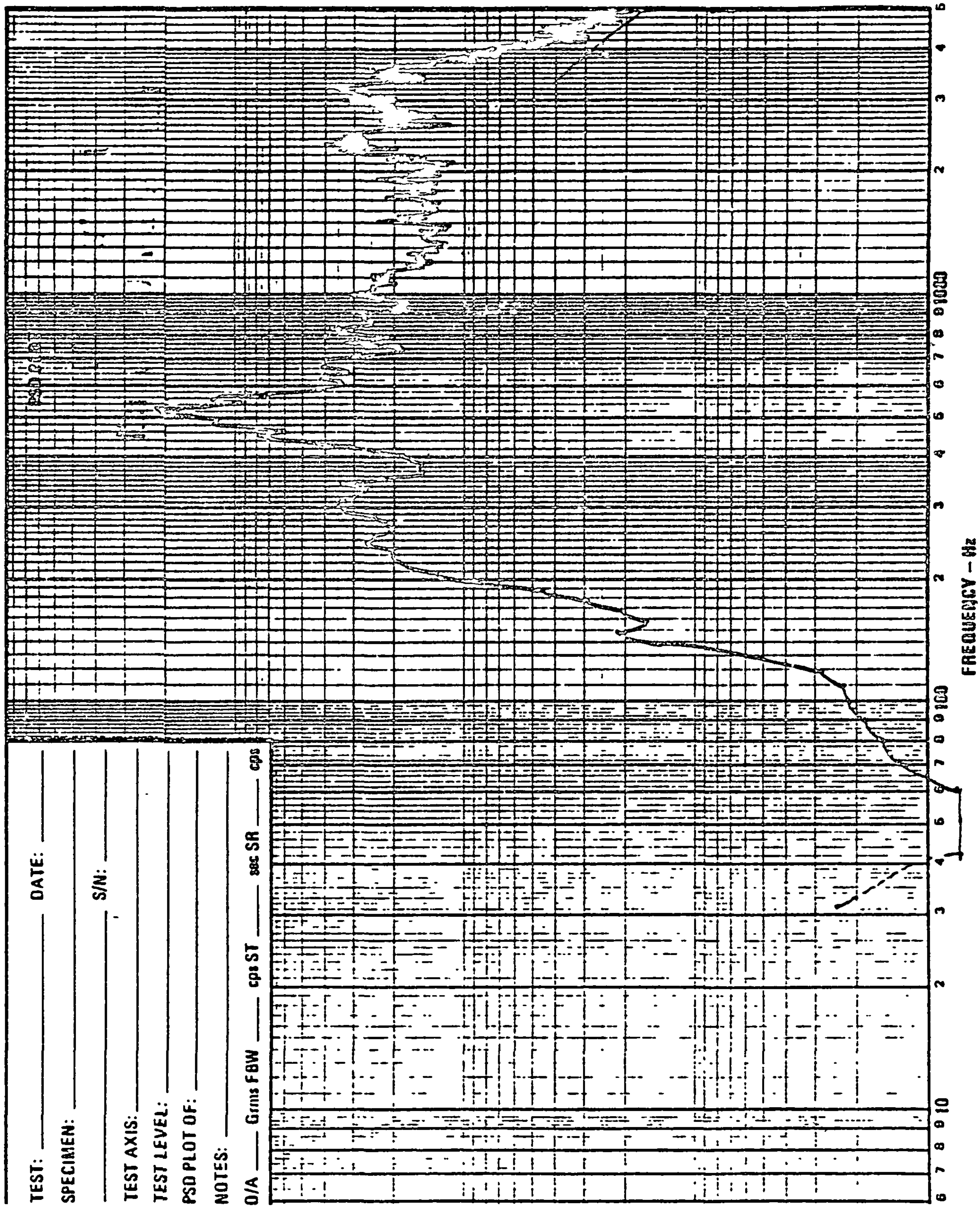

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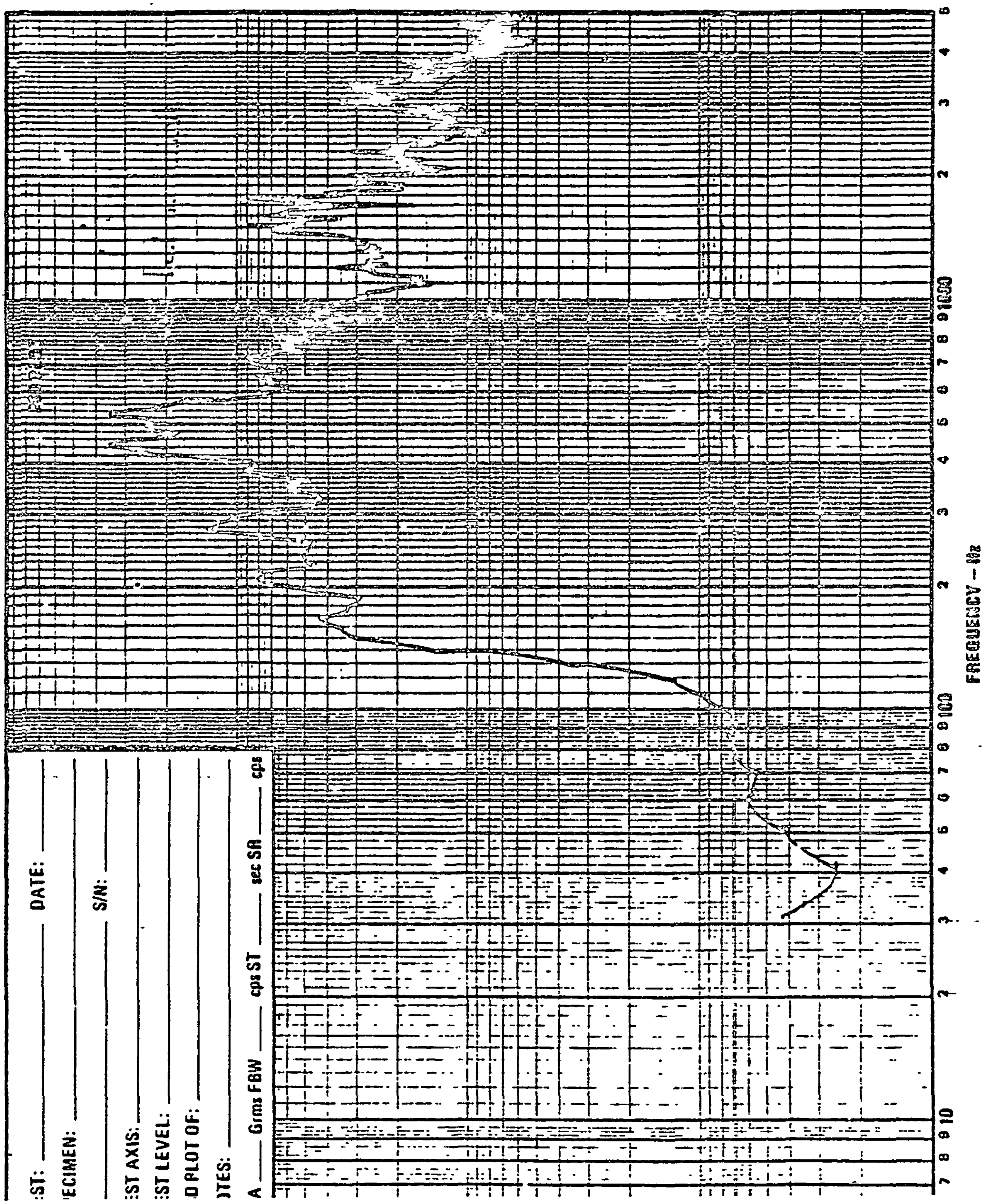

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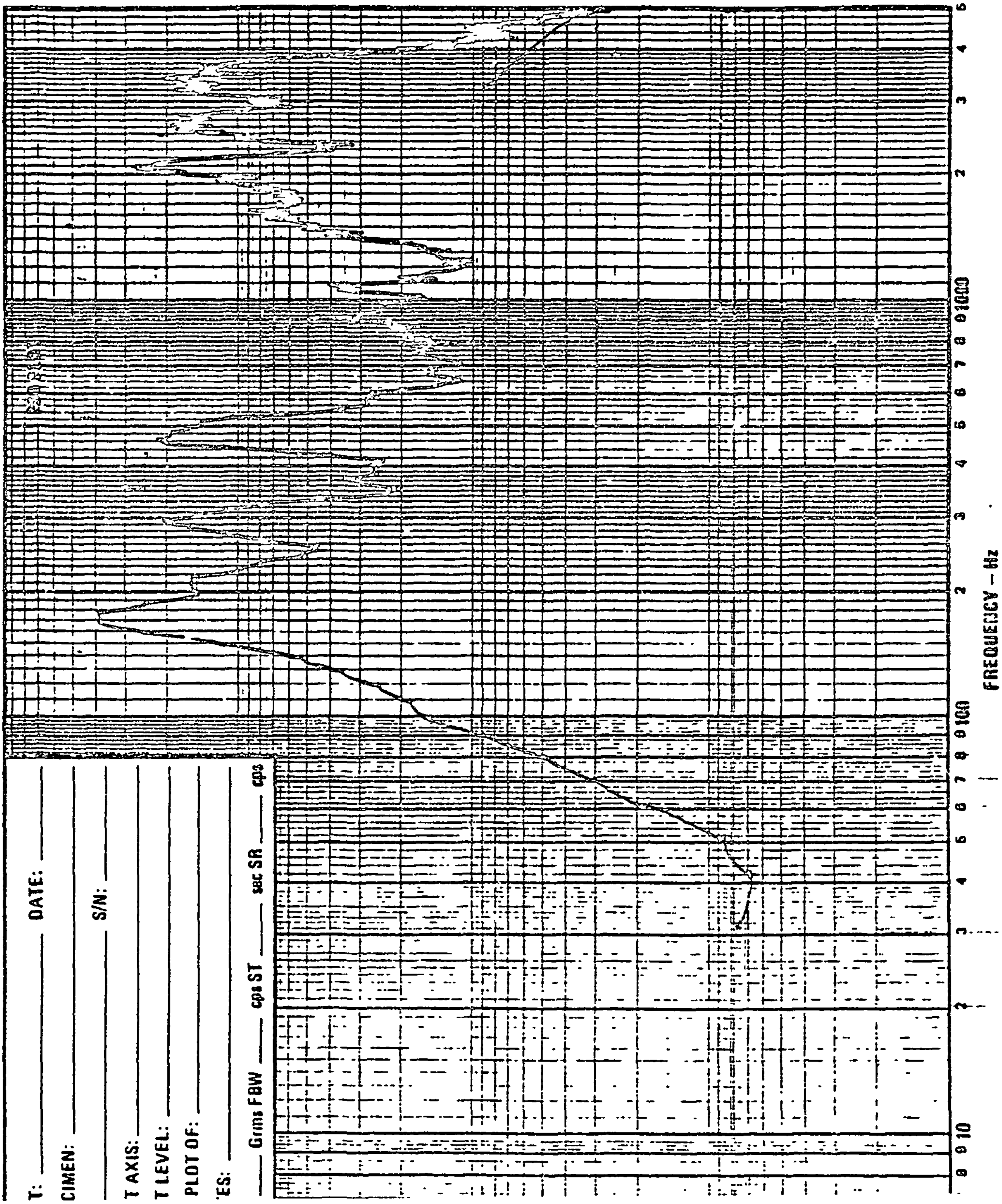

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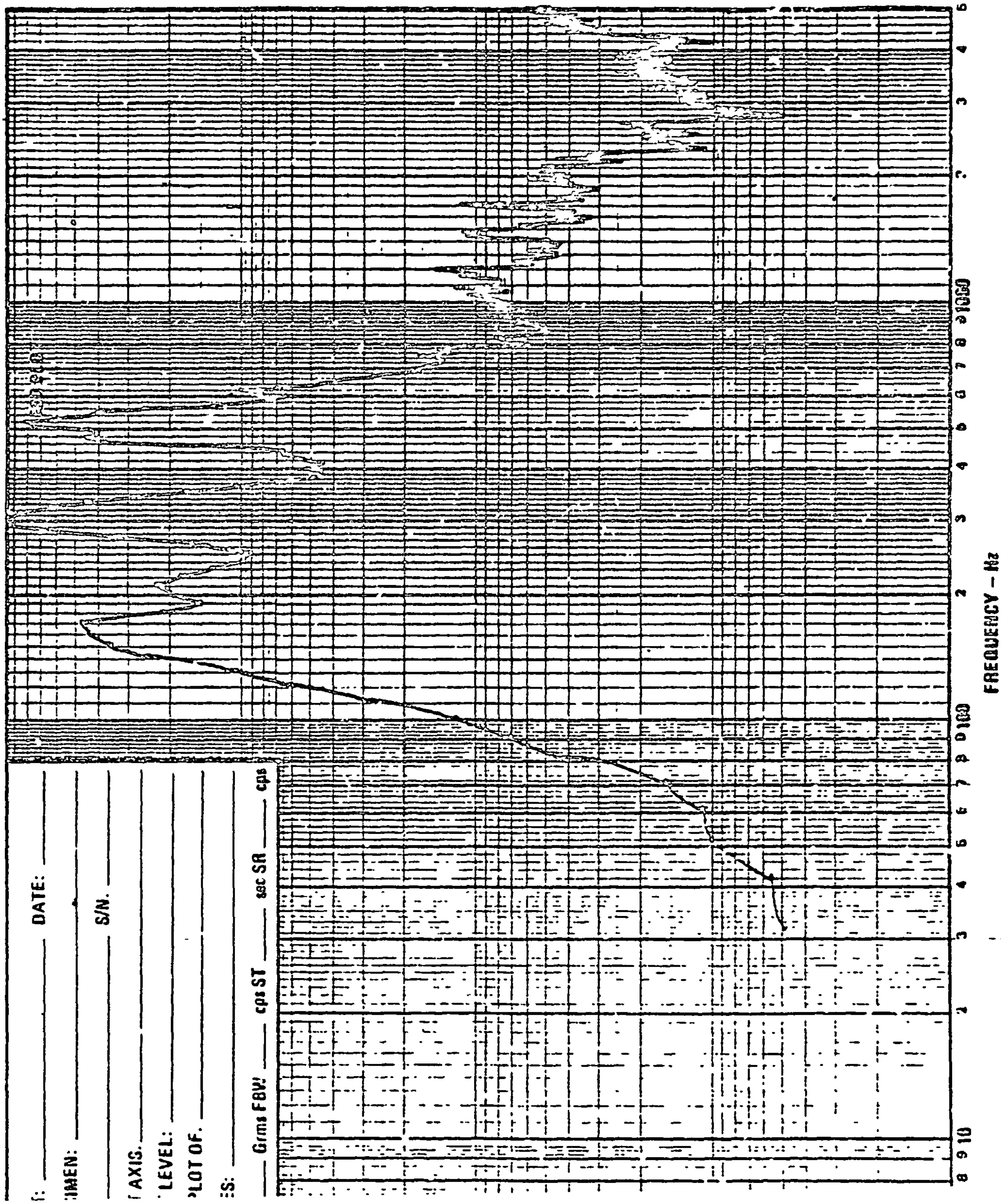

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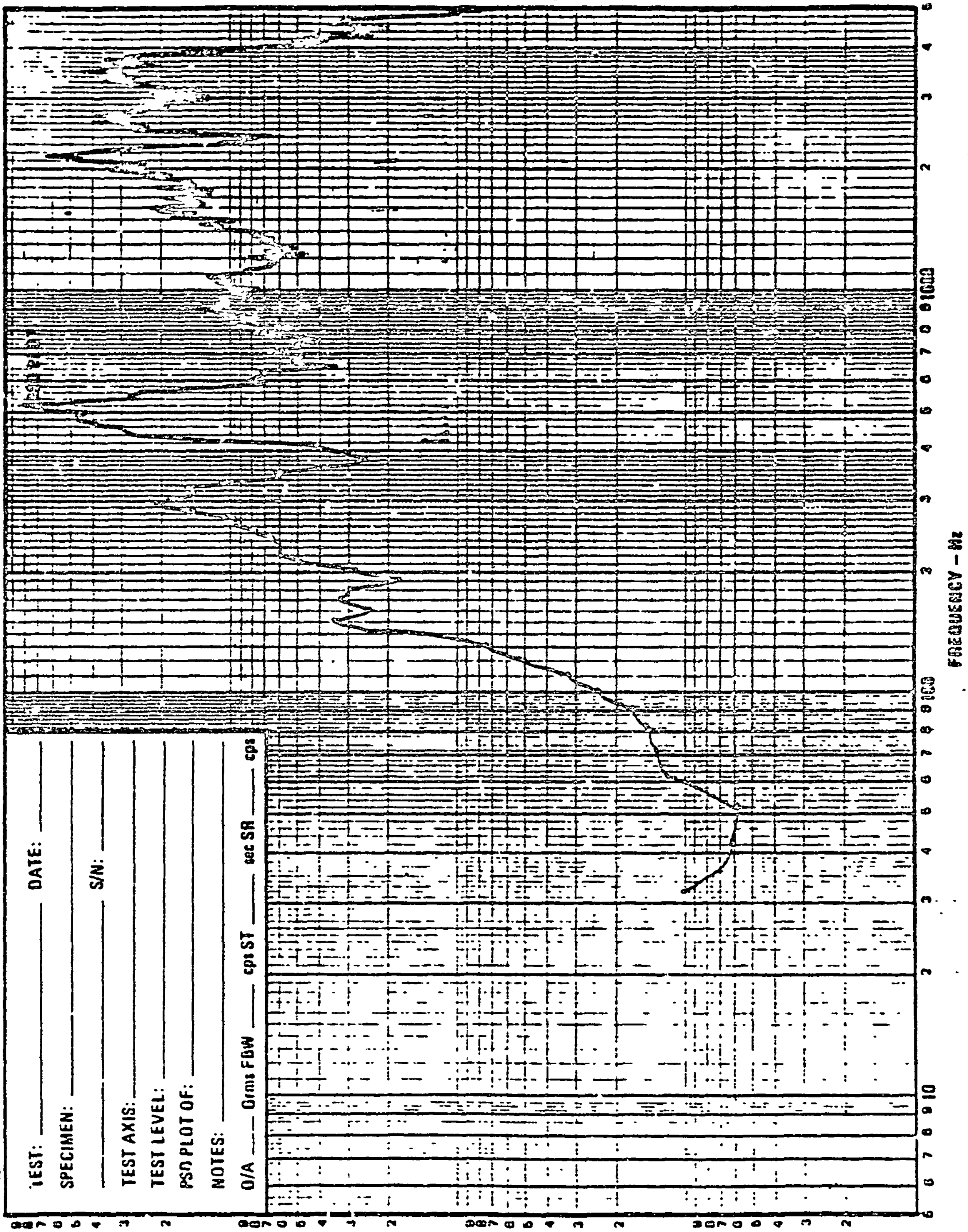

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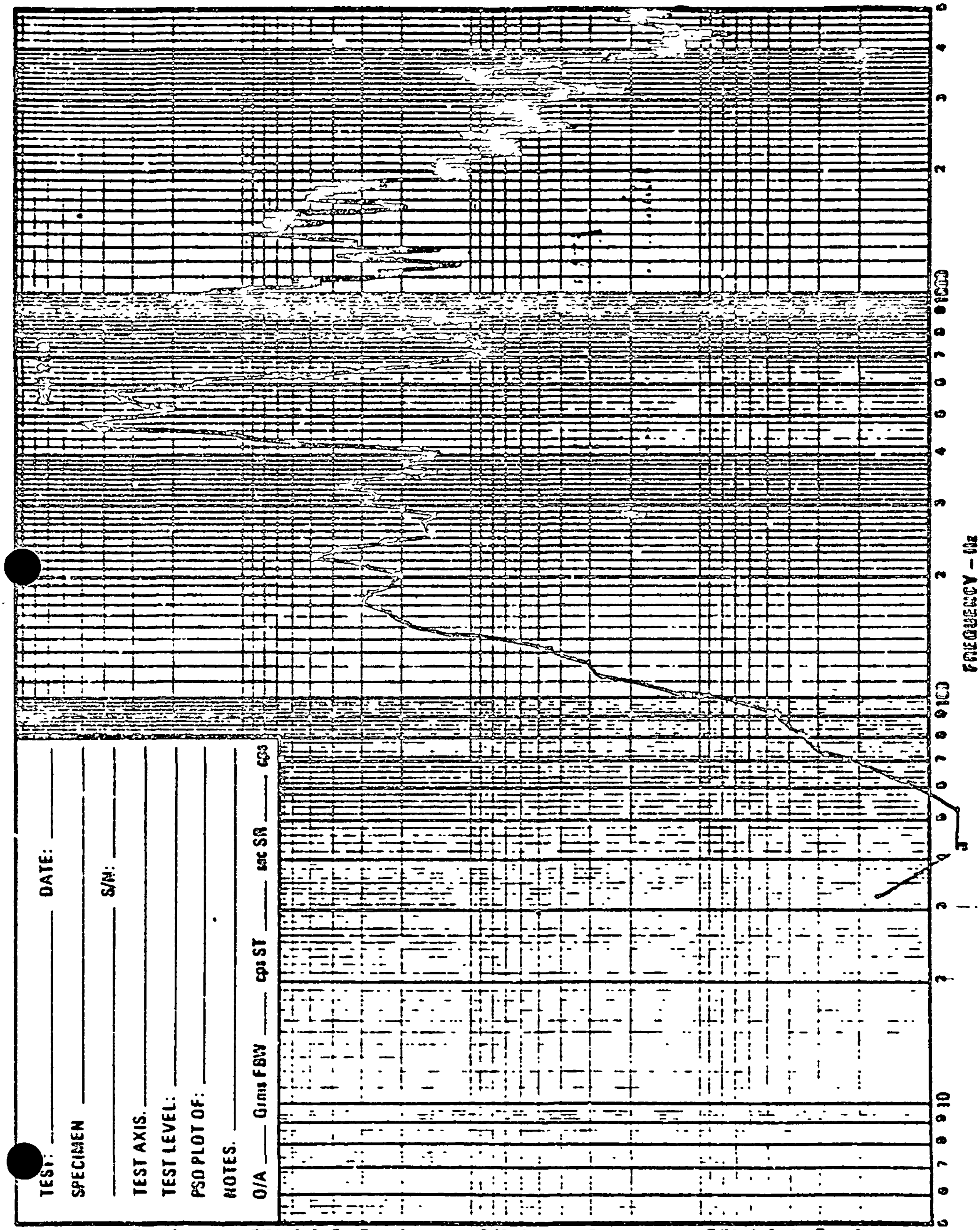

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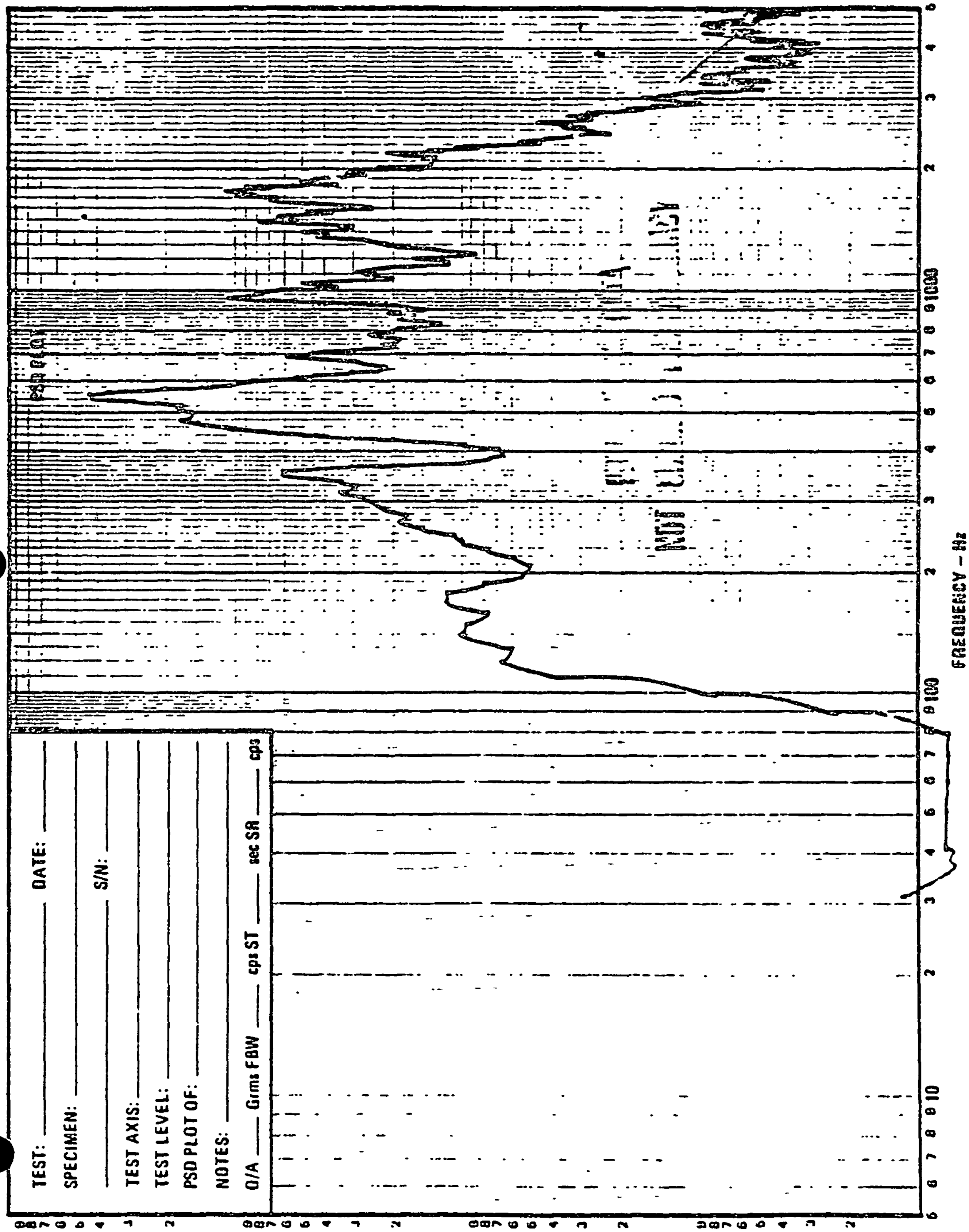

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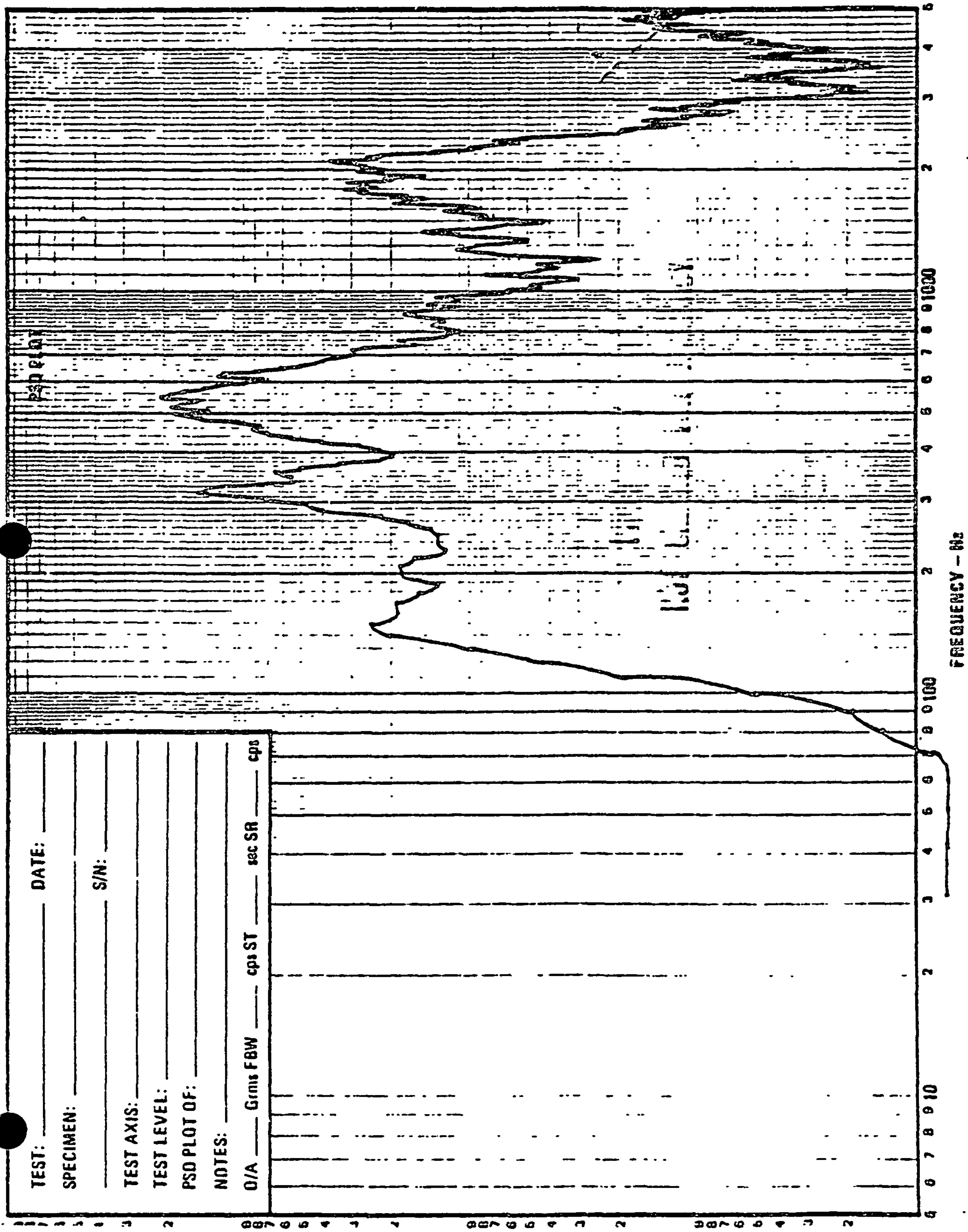

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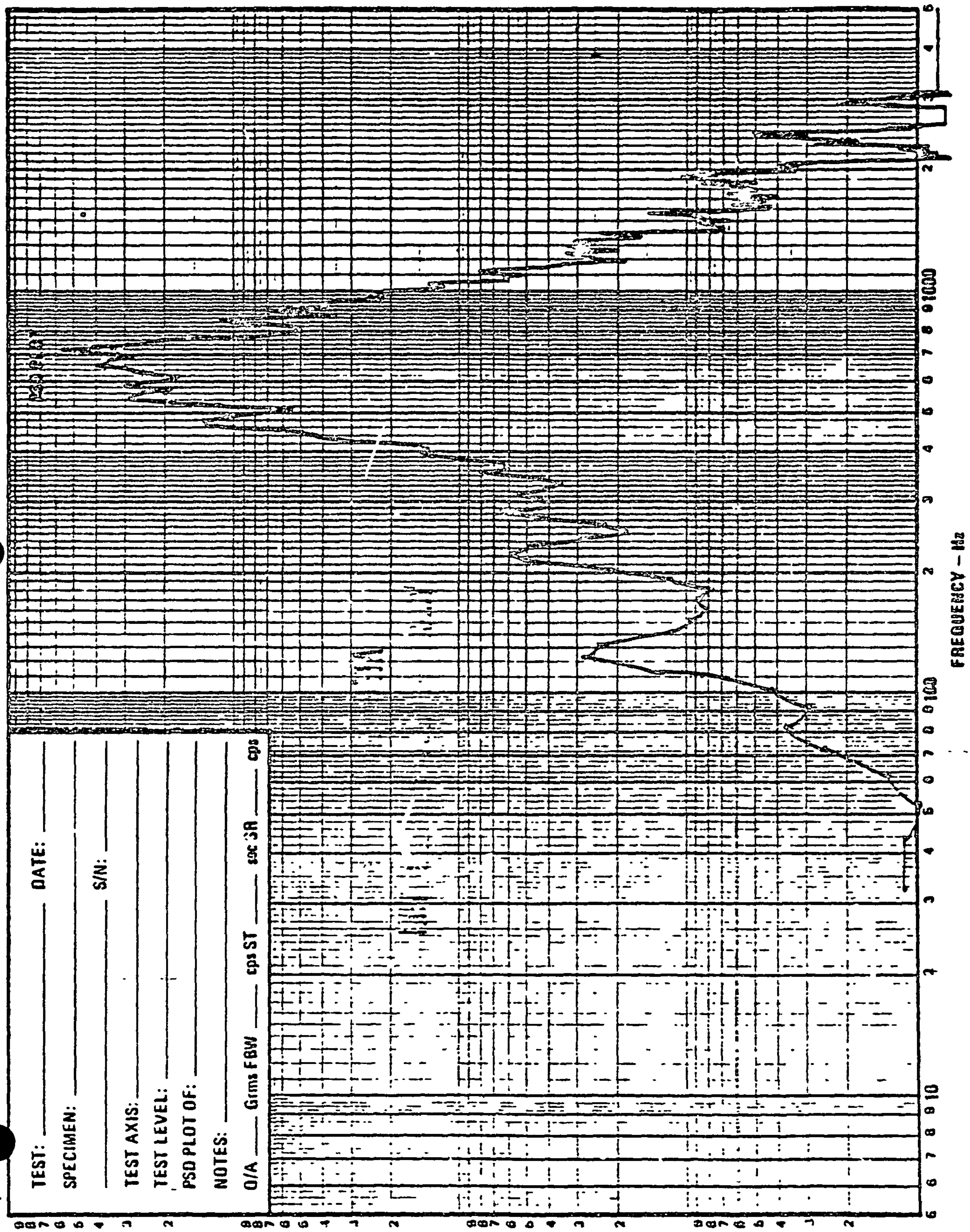

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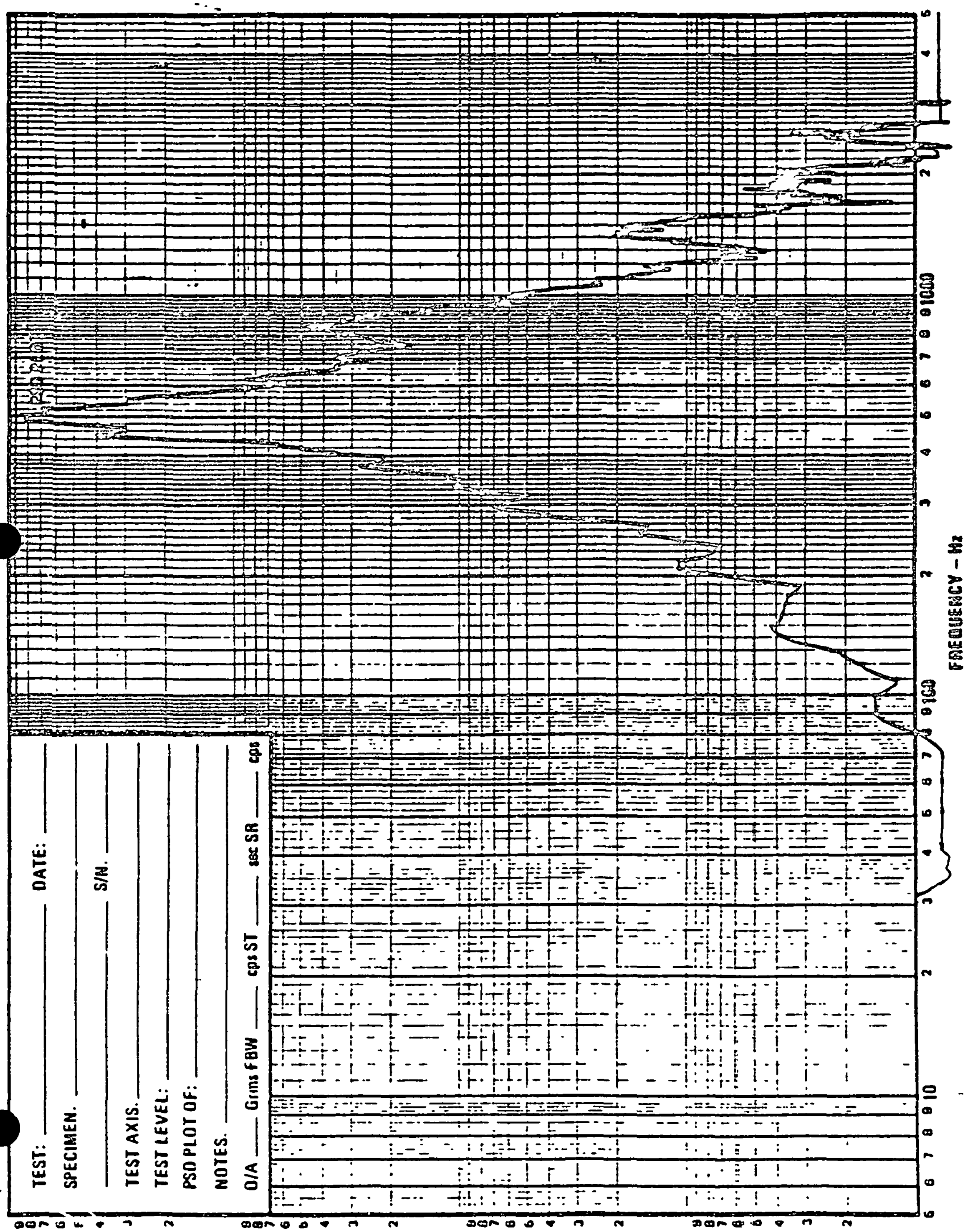

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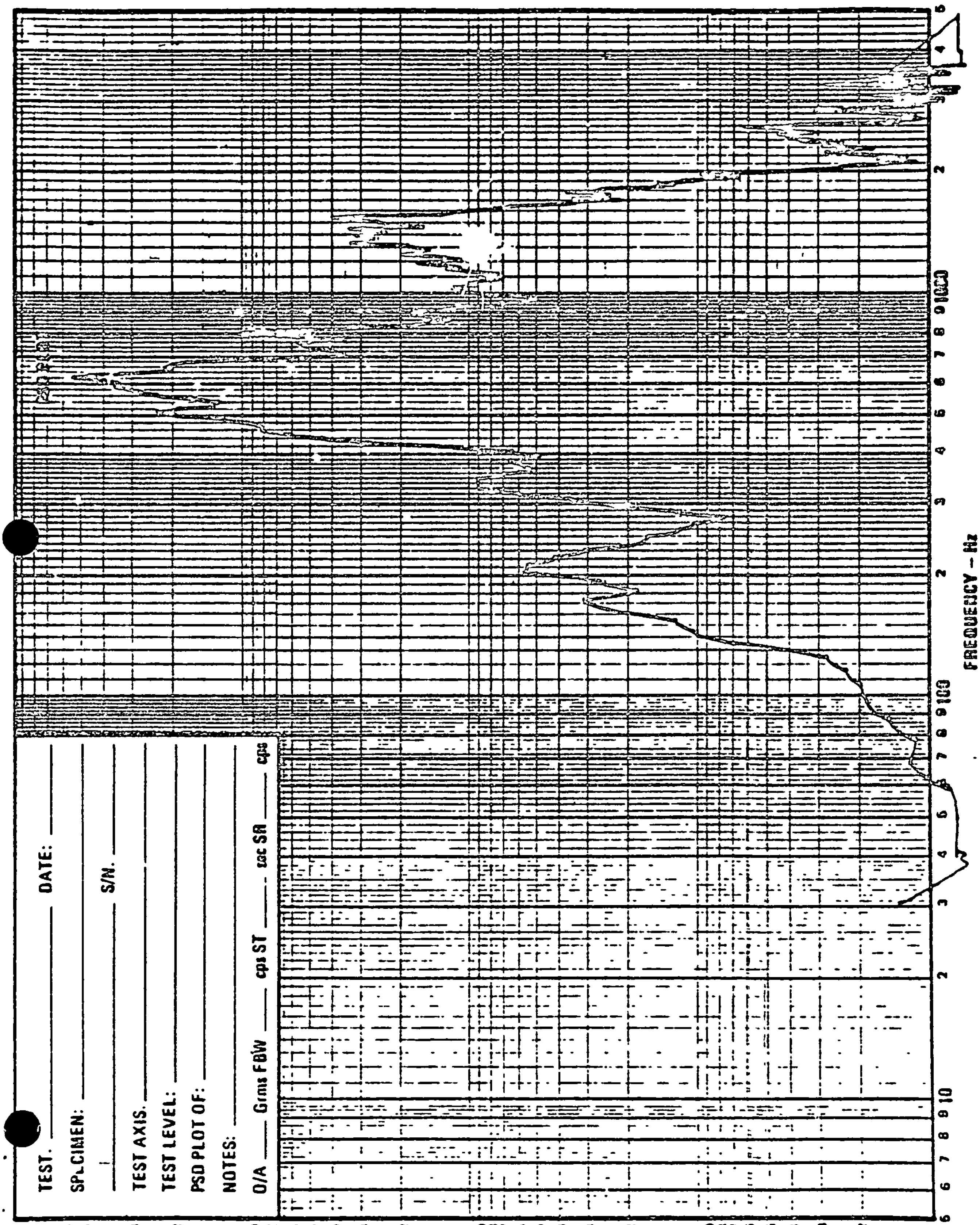

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SPECIMEN__________ S/N __________

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TAPE TRACK	ACCEL NO.	MV/G	O/A MV RMS	O/A G RMS
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D5	2Y			.32
D6	2Z			.17
D7	3X			.3
D8	3Y			.15
D9	3Z			.44
D10	4X			.68
D11	4Y			.6
D12	4Z			.48

REMARKS __________

TEST__________ DATE__________

SPECIMEN__________ S/N __________

COMPLEX_____ RANDOM ONLY_____ TAPE NO._____ RUN NO._____

TAPE TRACK	ACCEL NO.	MV/G	O/A MV RMS	O/A G RMS
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2	1Y			.5
3	1Z			.65
4	2X			.82
5	2Y			1.6
6	2Z			.8
7	3X			.95
8	3Y			.85
9	3Z			1.4
10	4X			5.7
11	4Y			5.8
12	4Z			5.4
C 7	5X			1.8
C 8	5Y			1.9
C 9	5Z			1.6

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REMARKS __________

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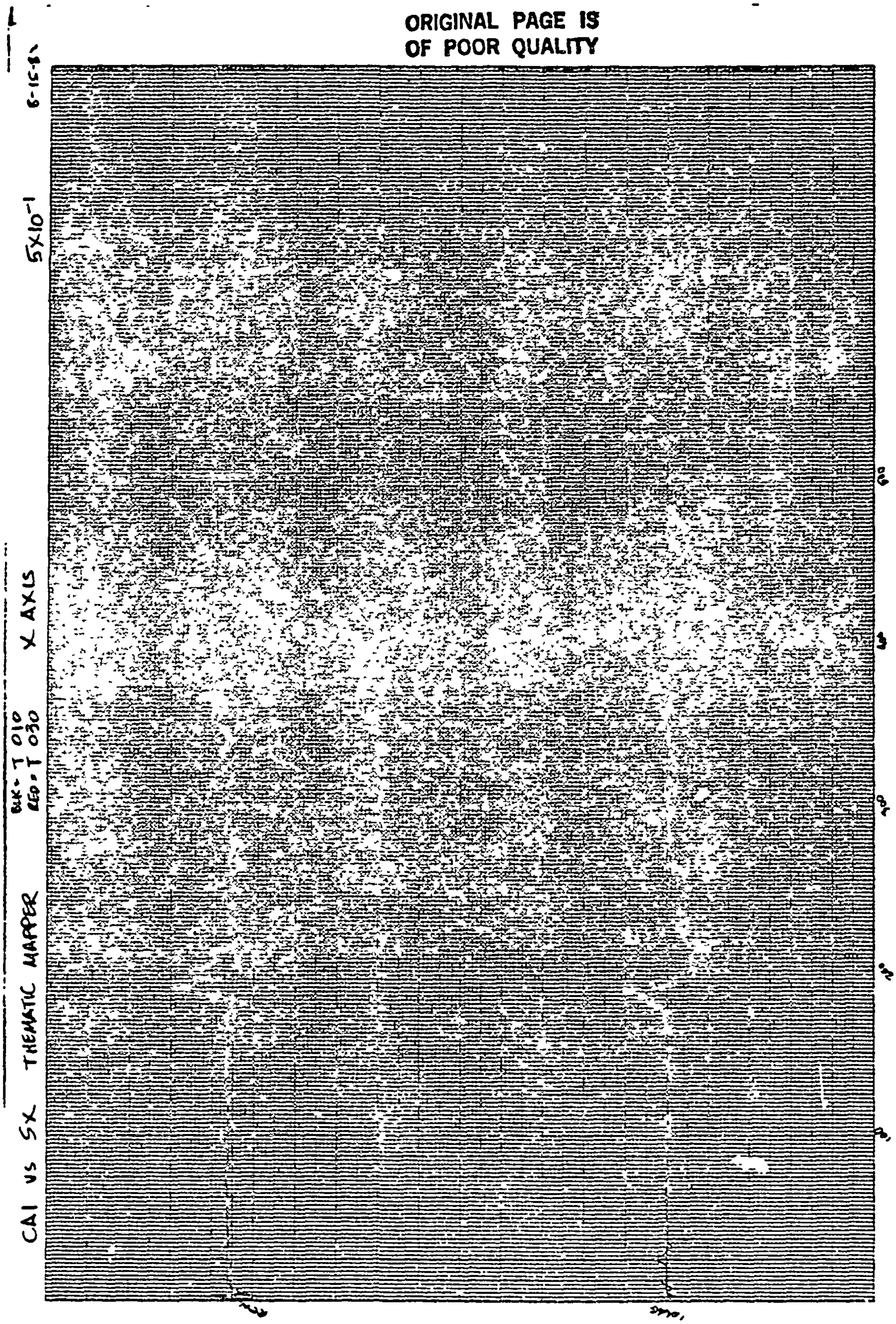

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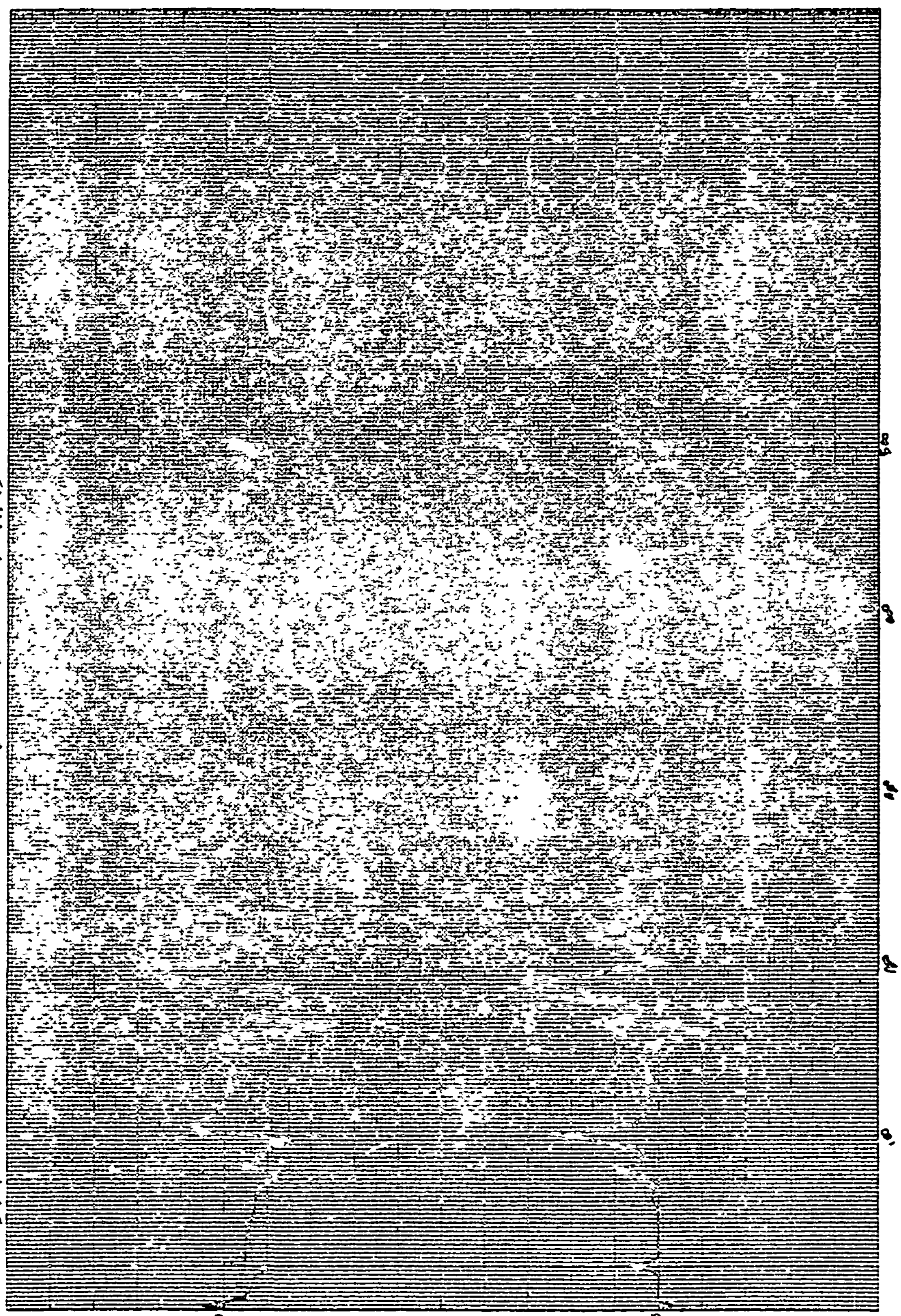

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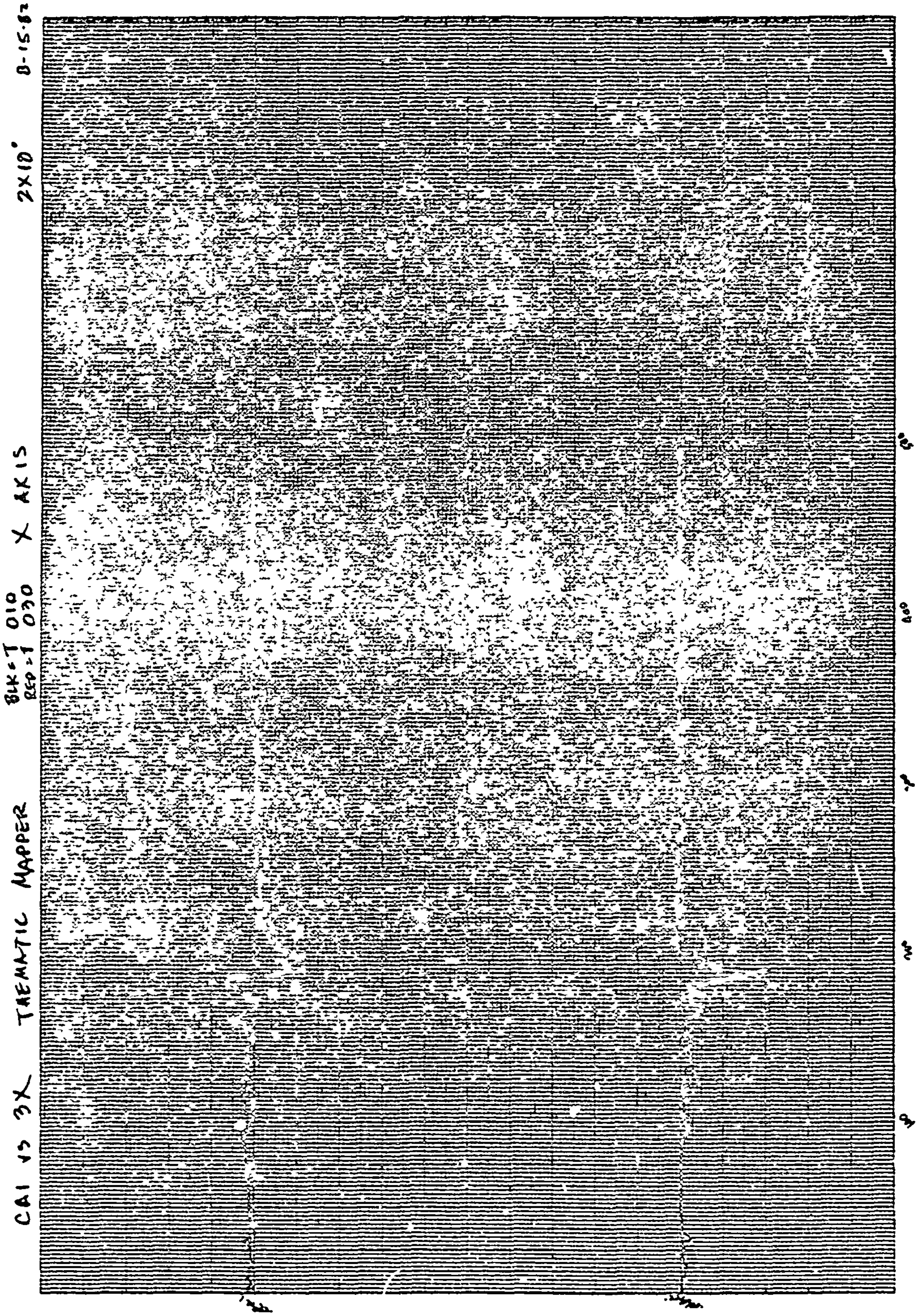

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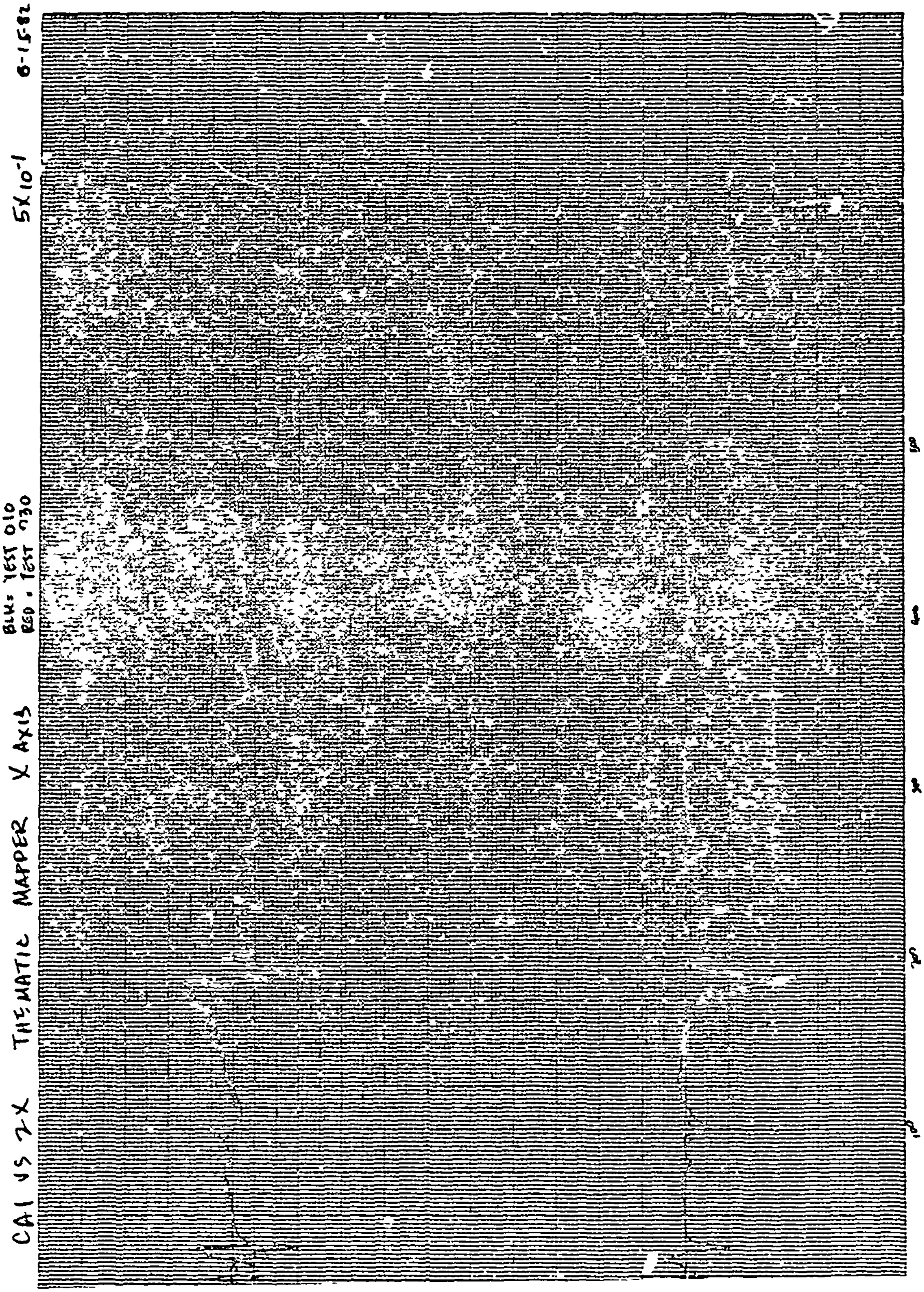

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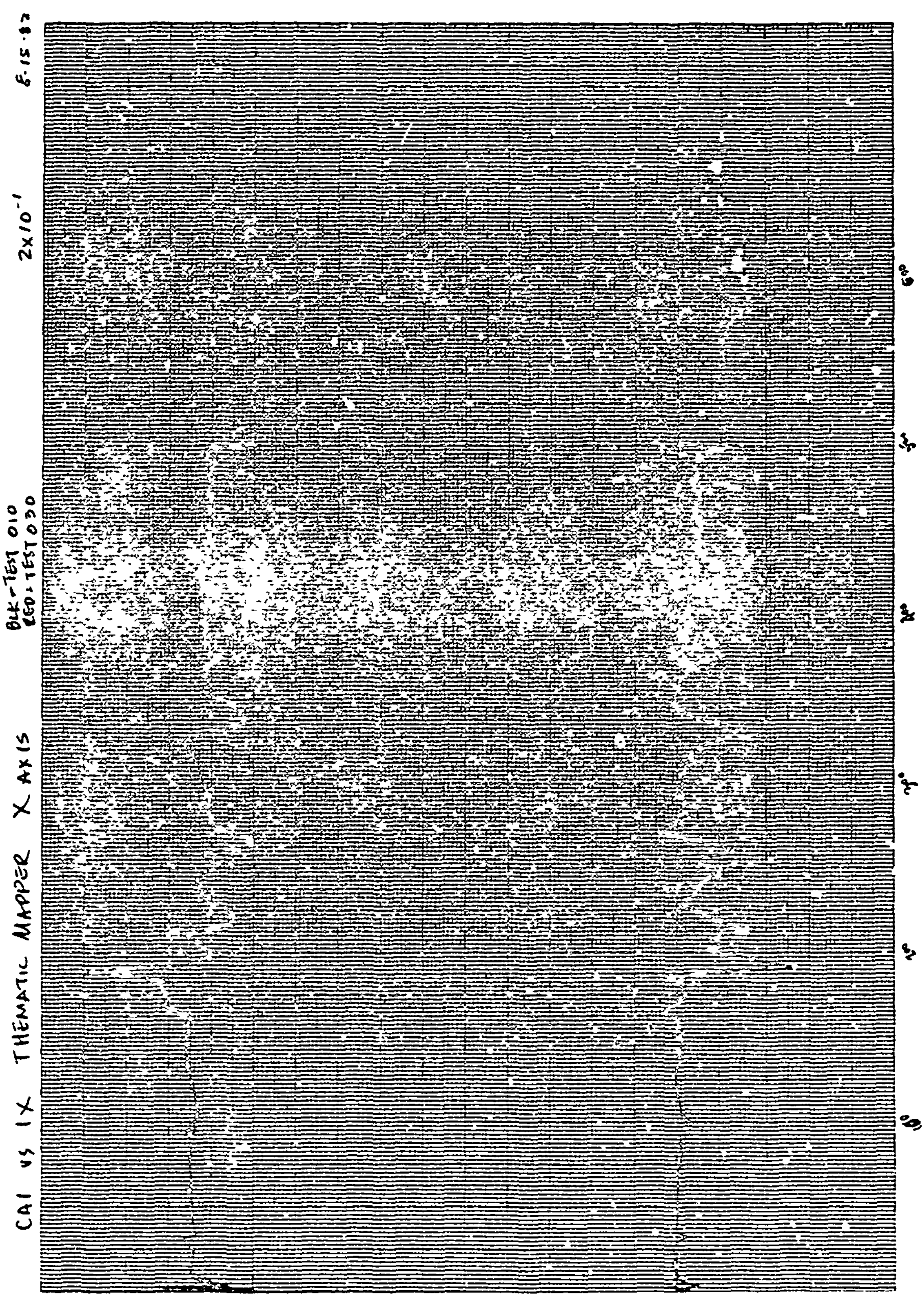

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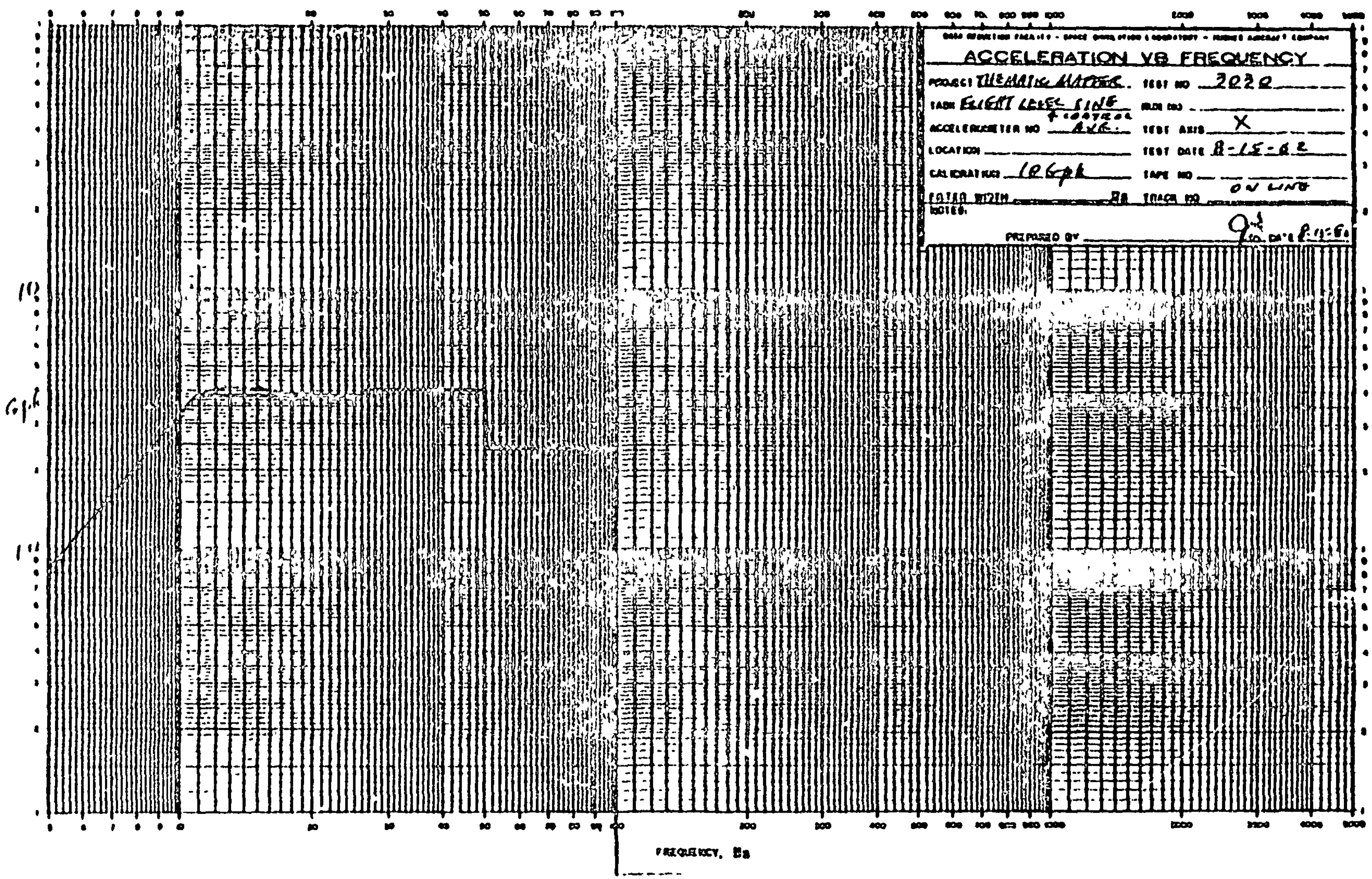

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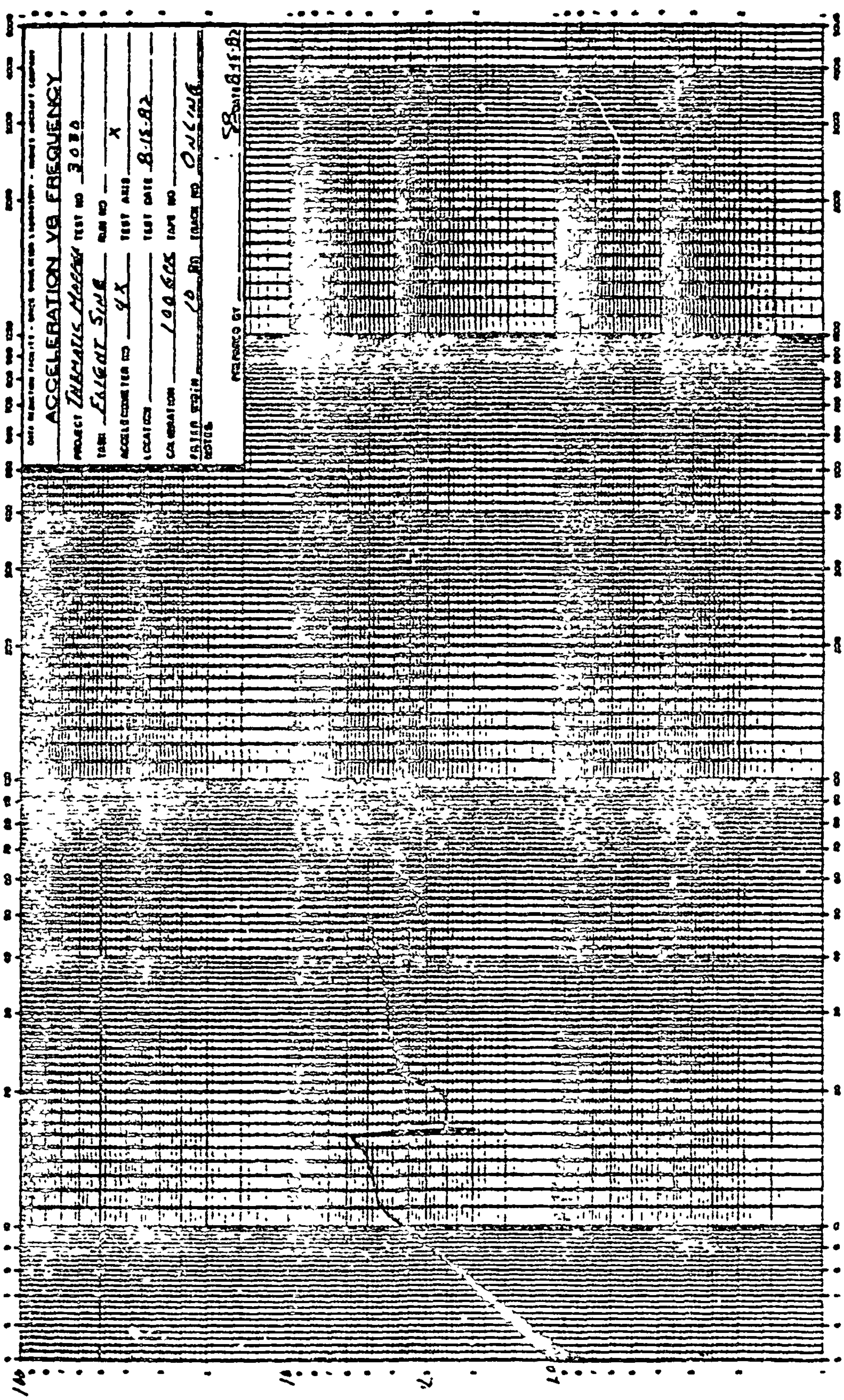

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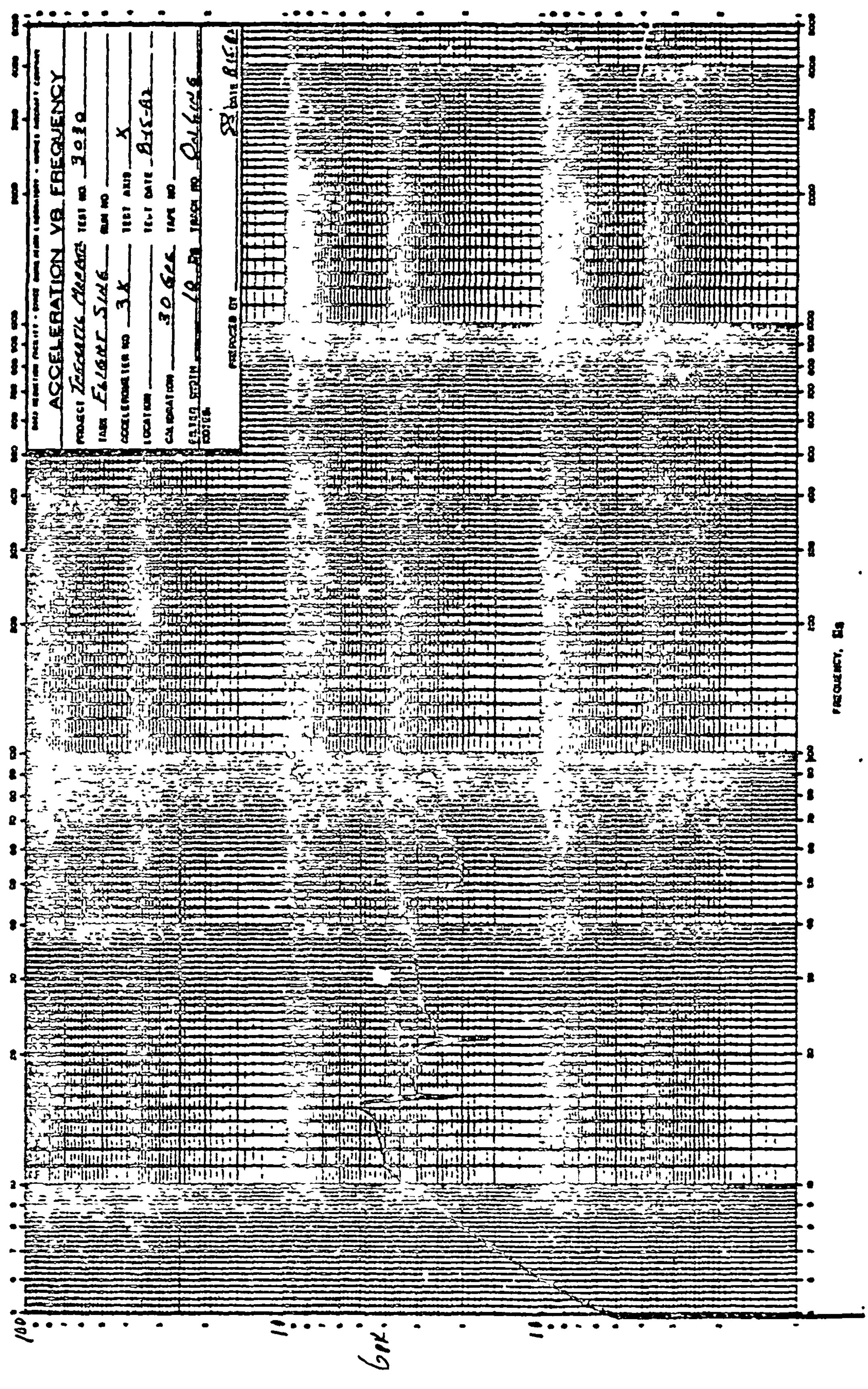

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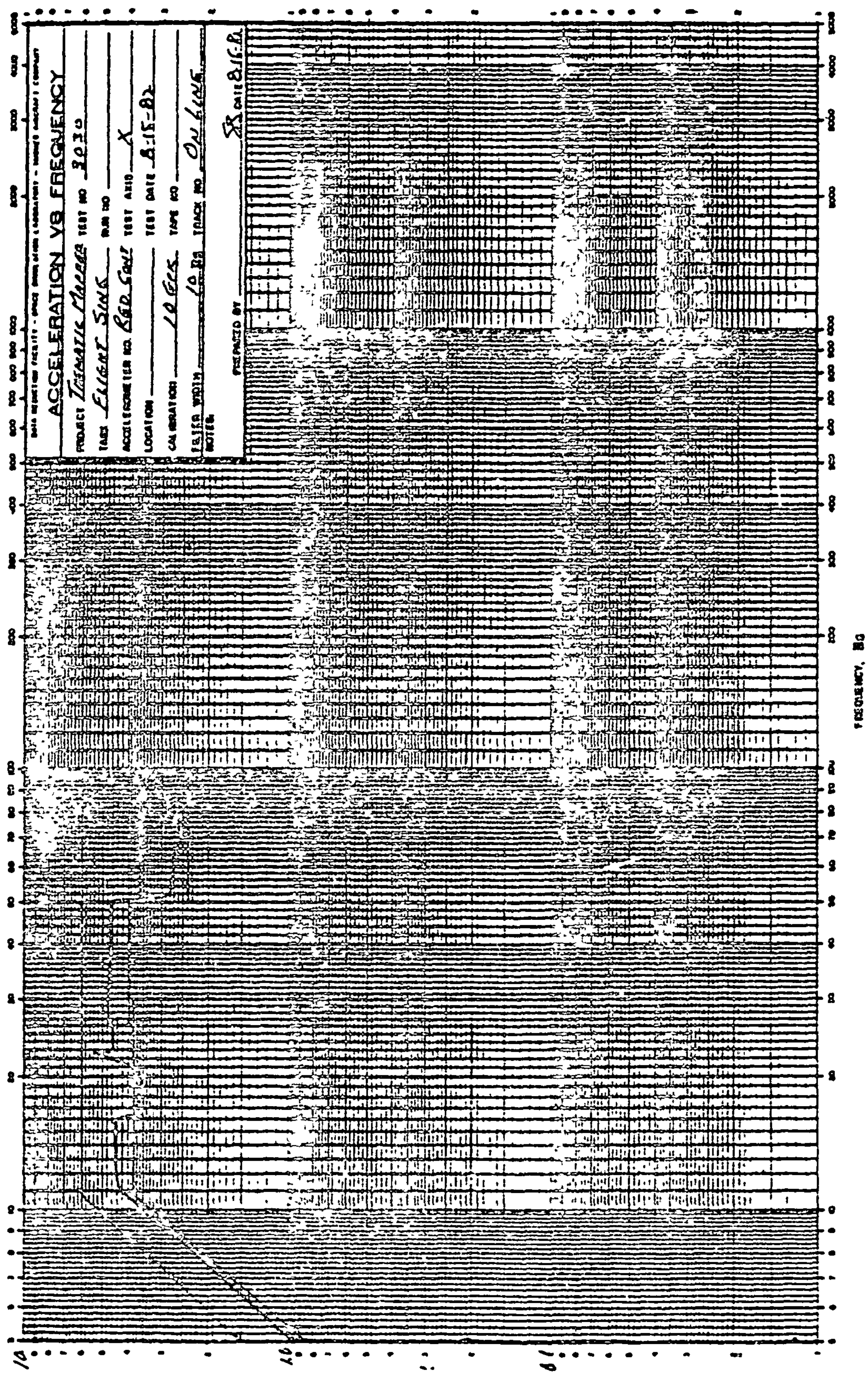

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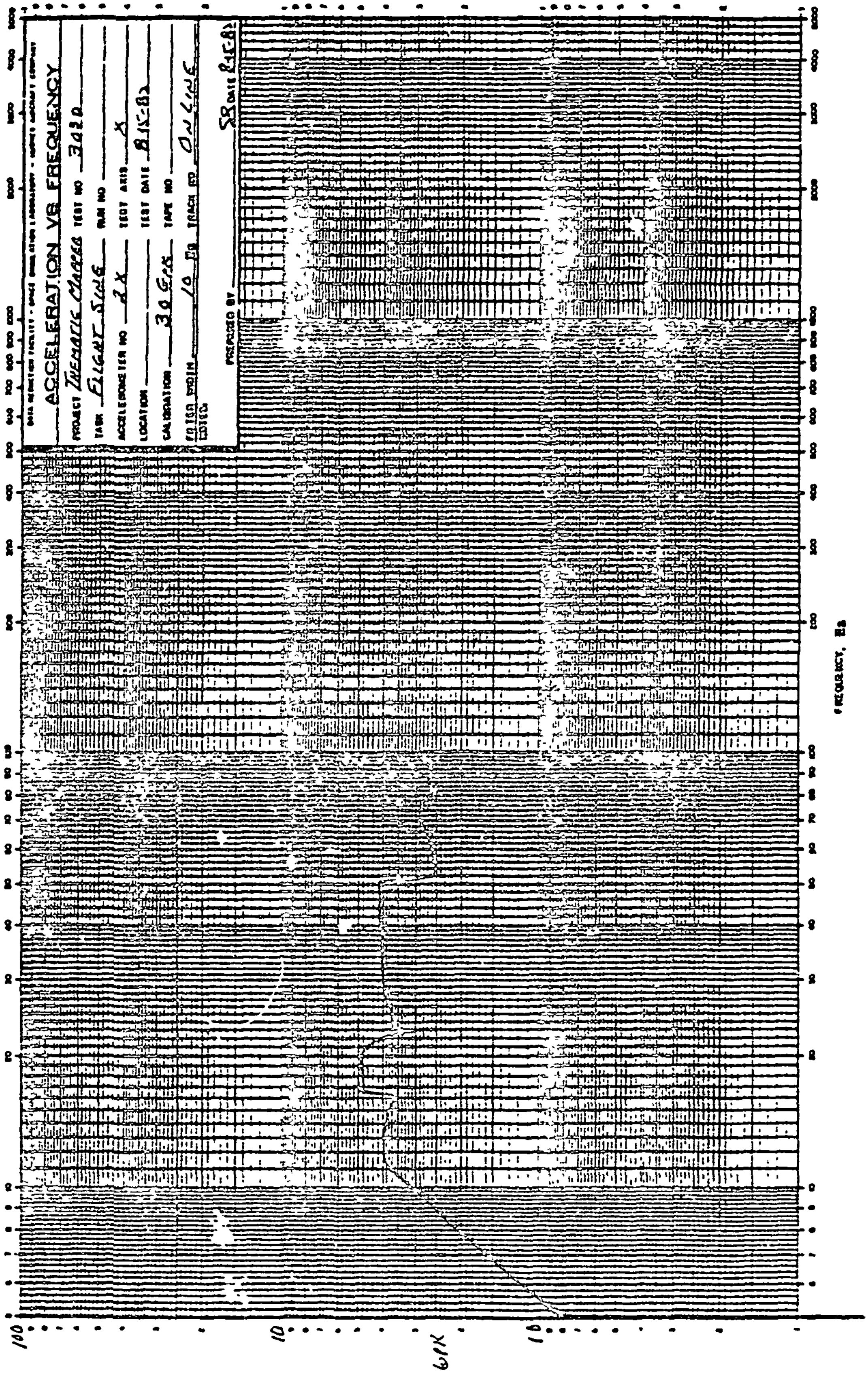

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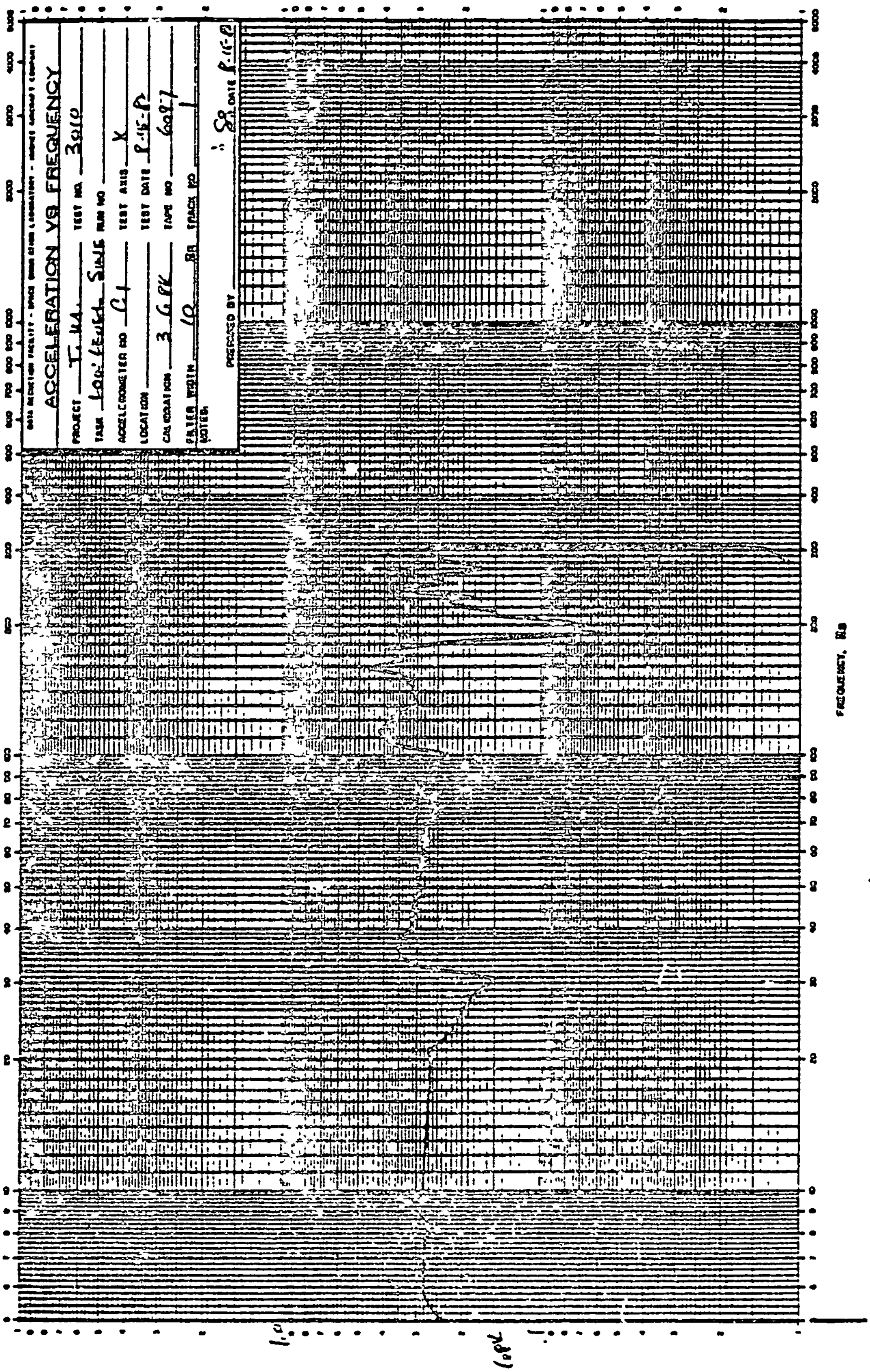

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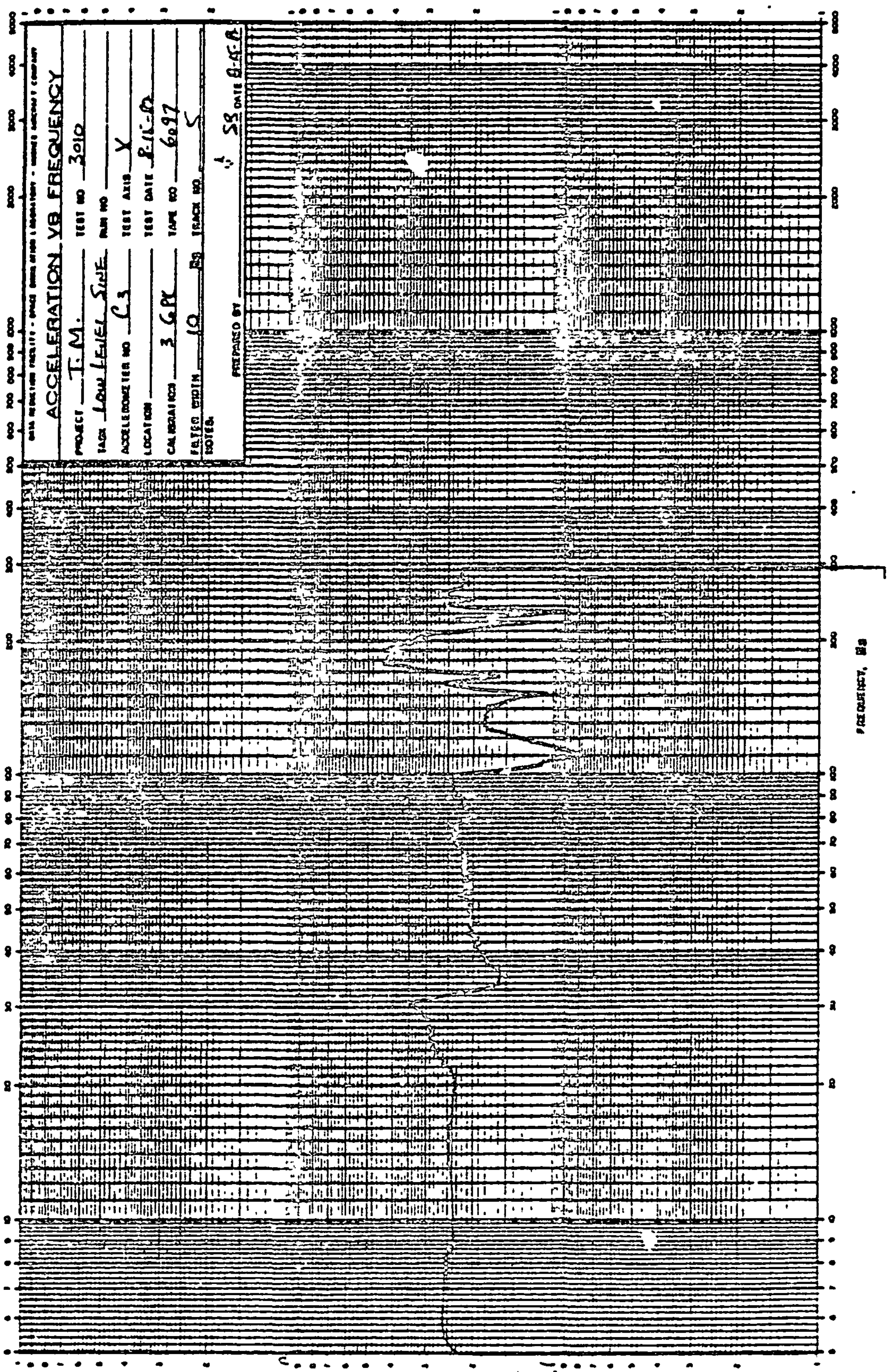

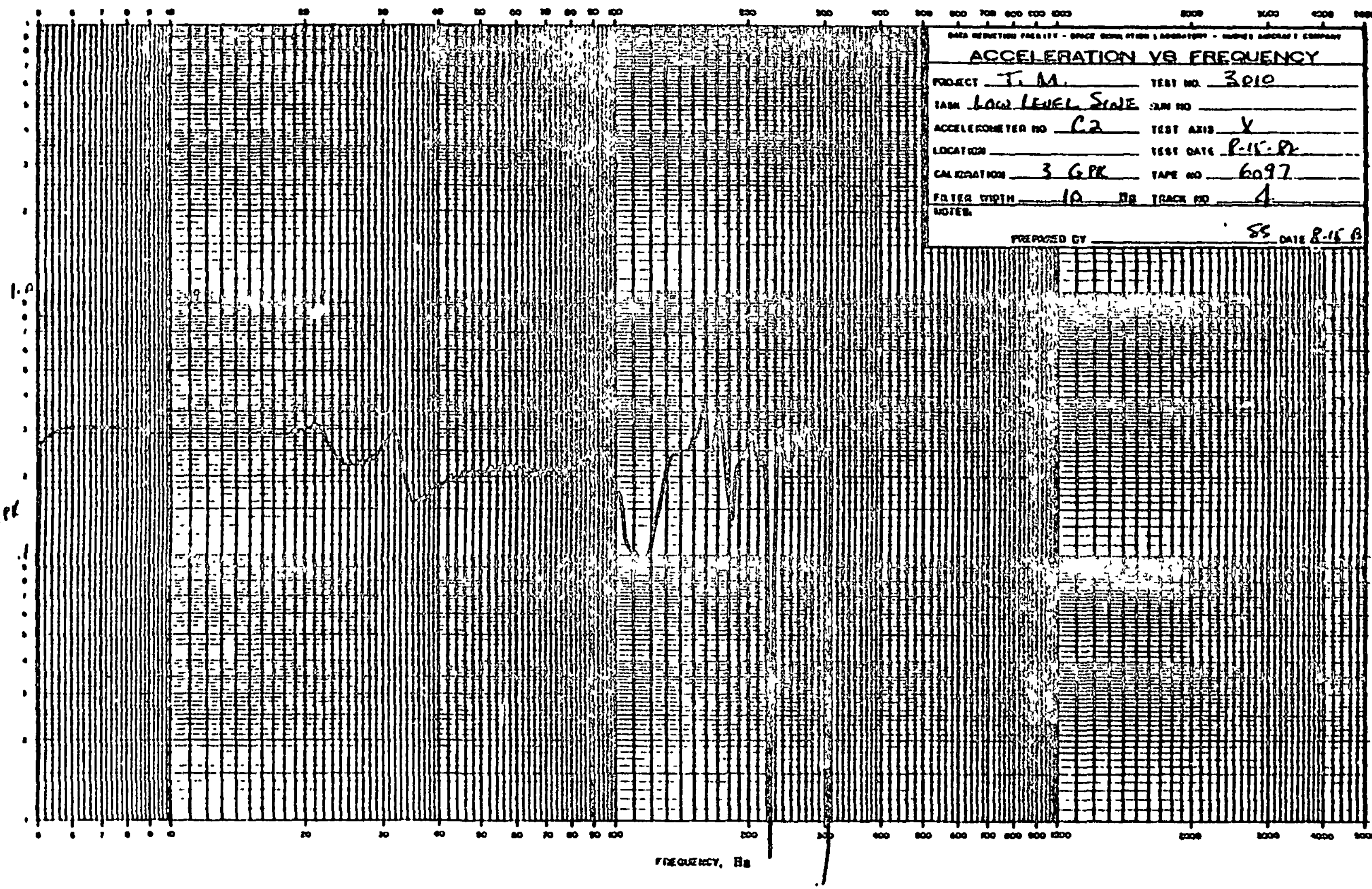

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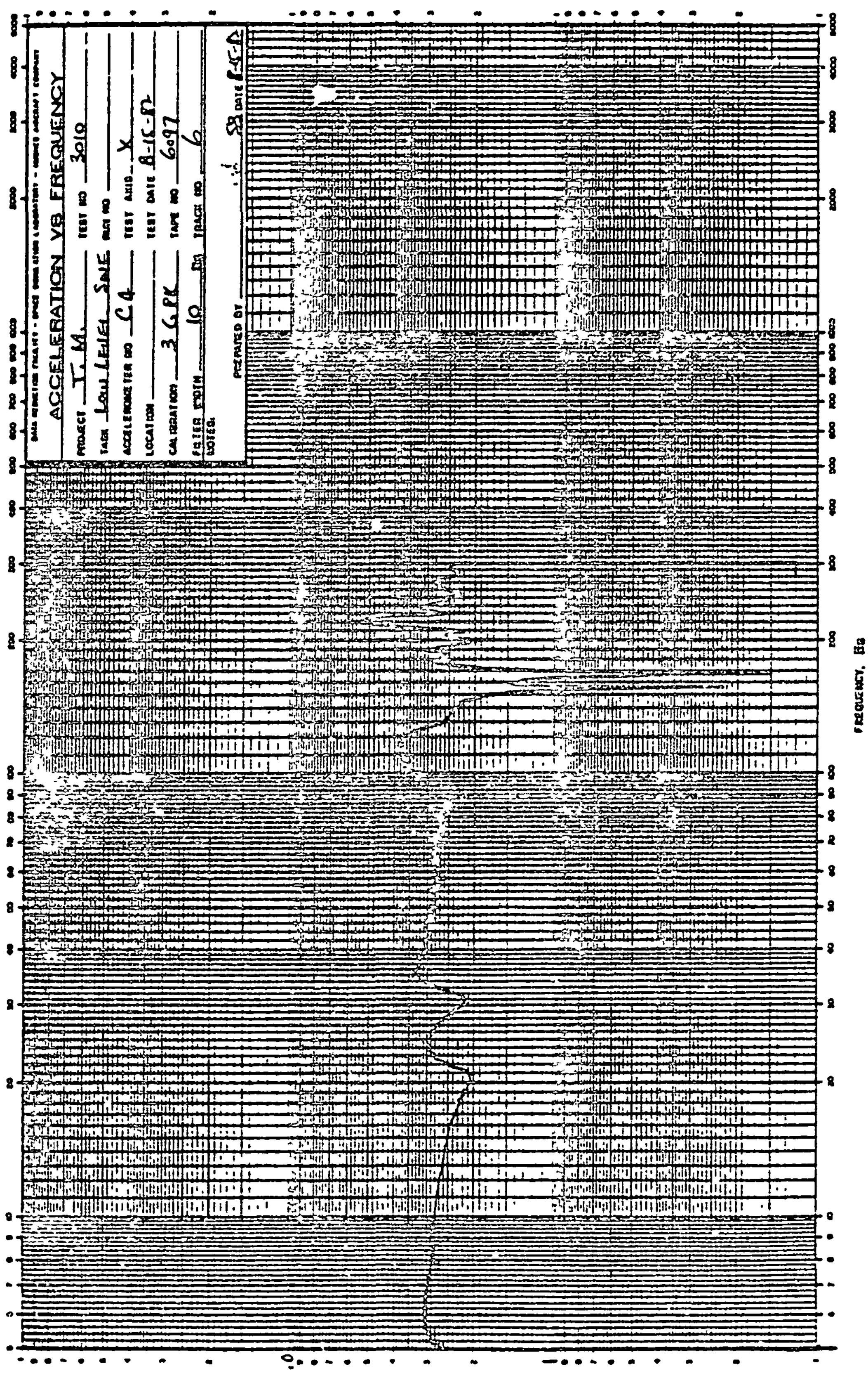

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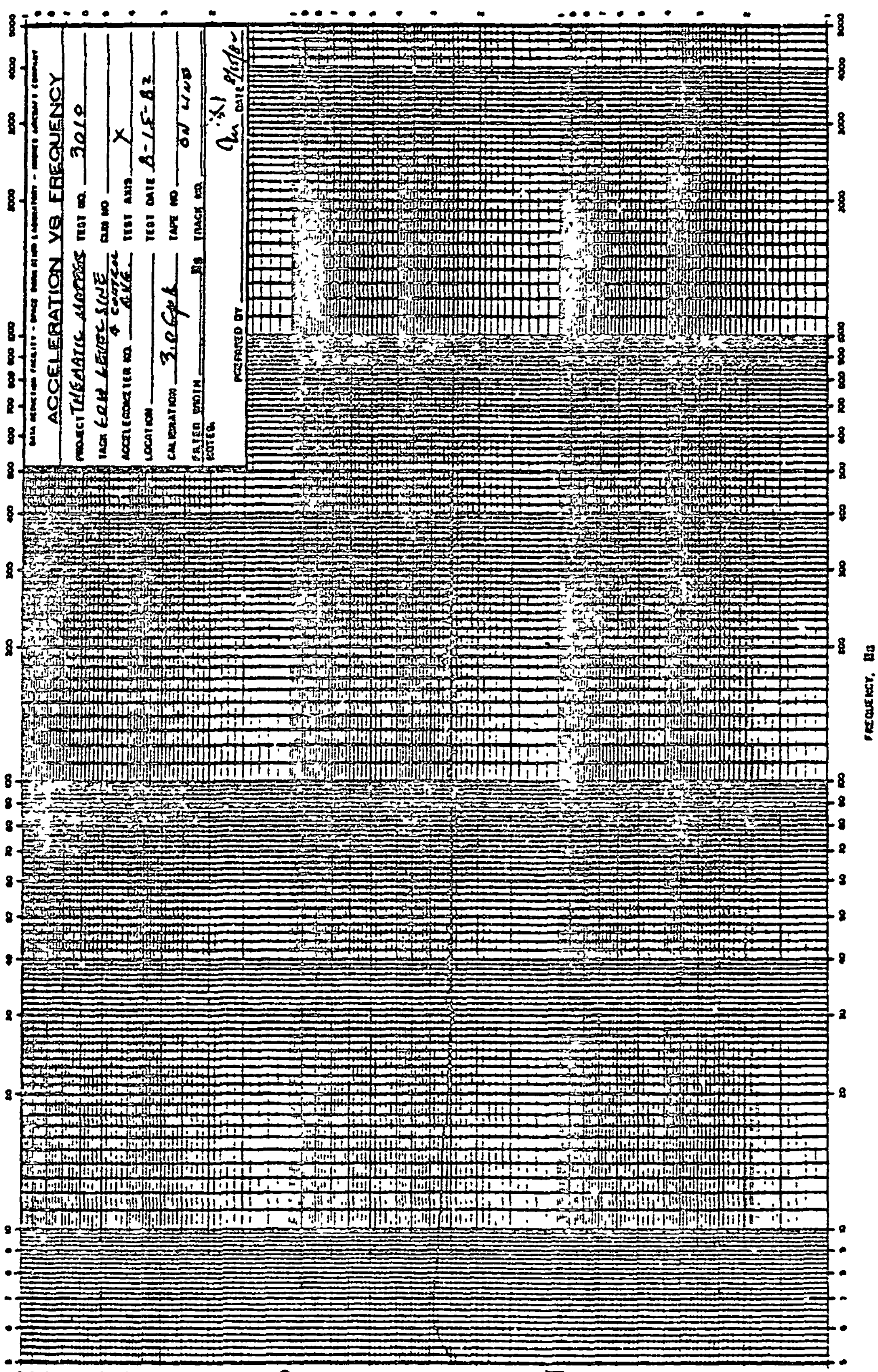

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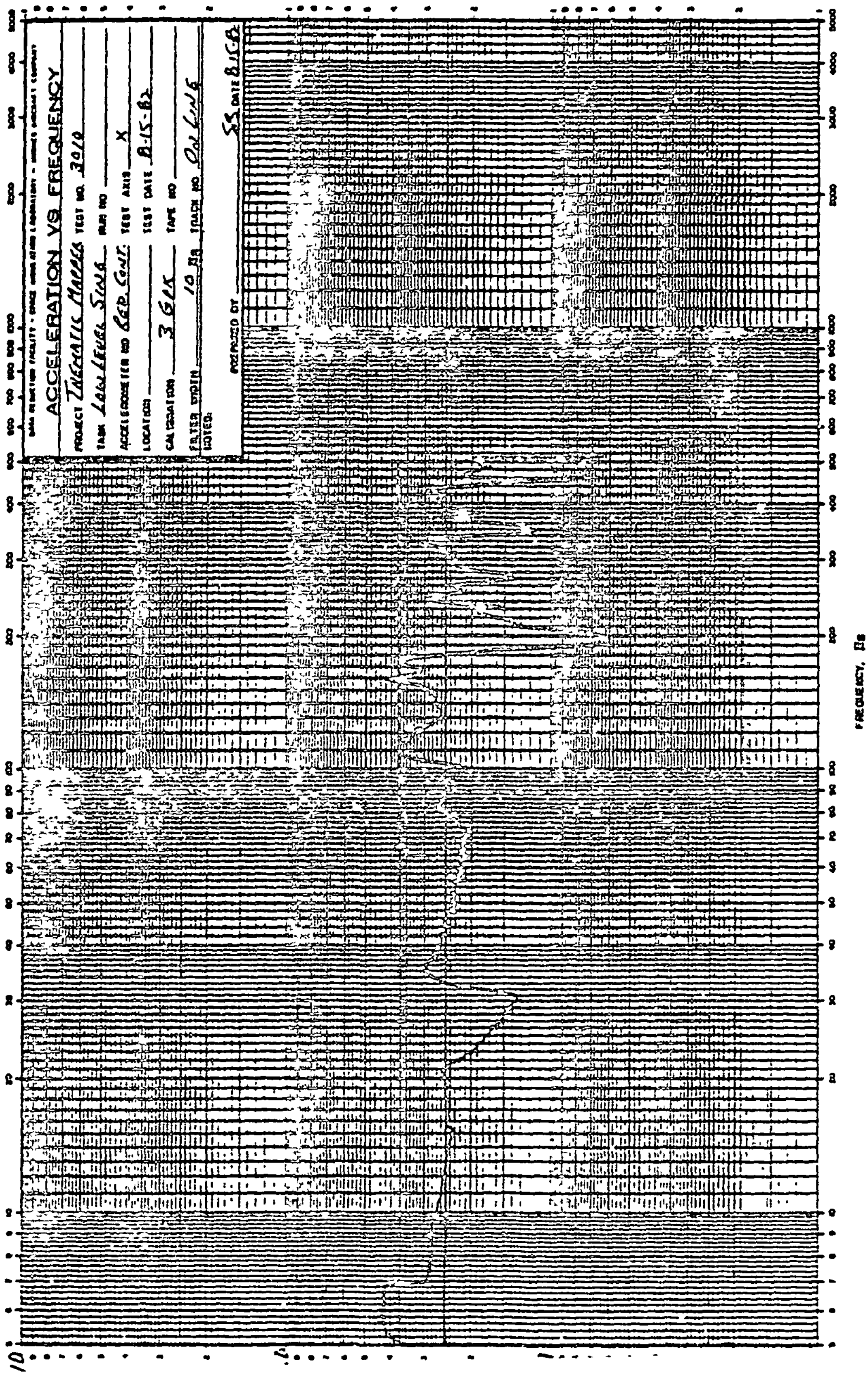

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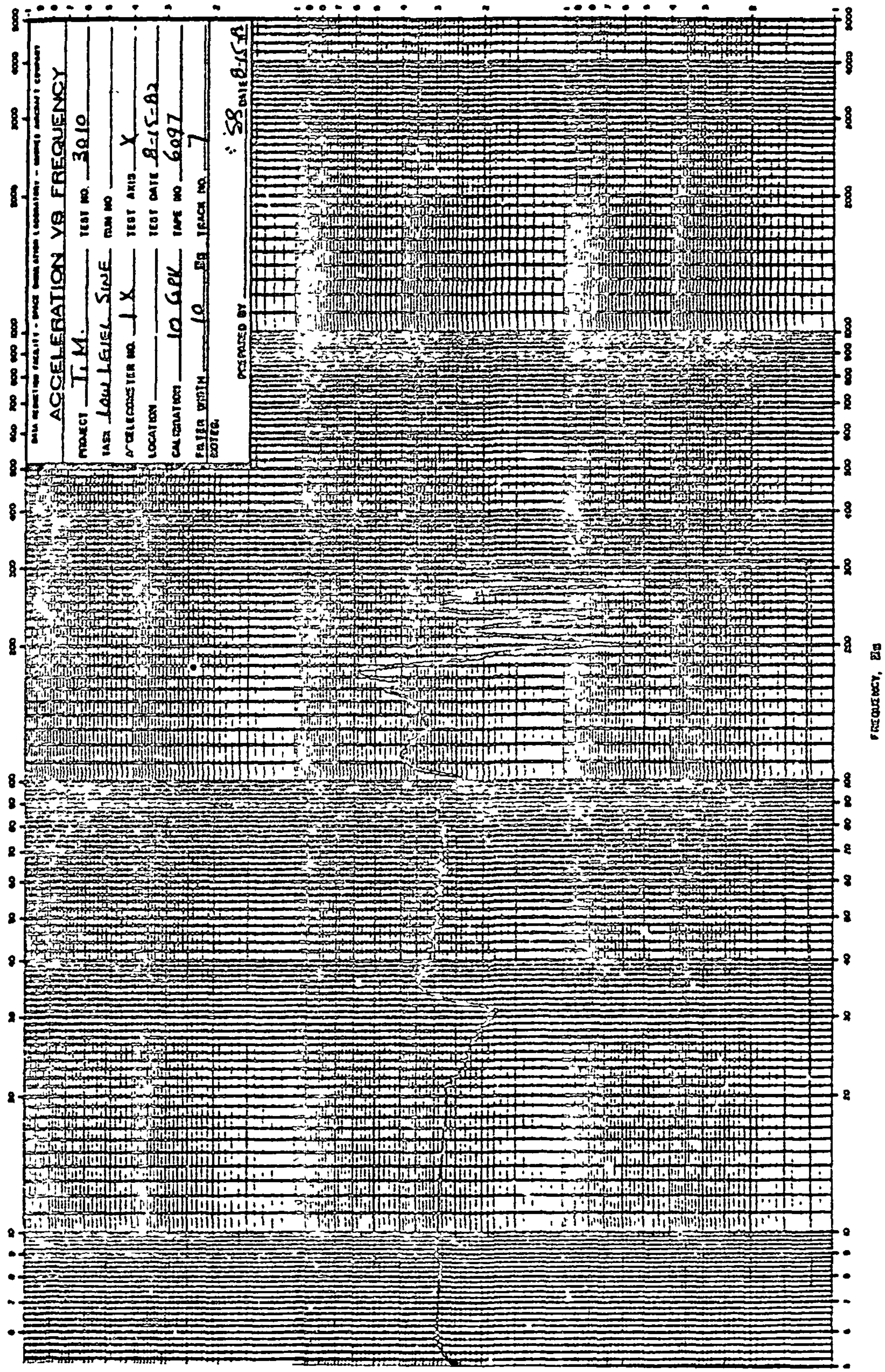

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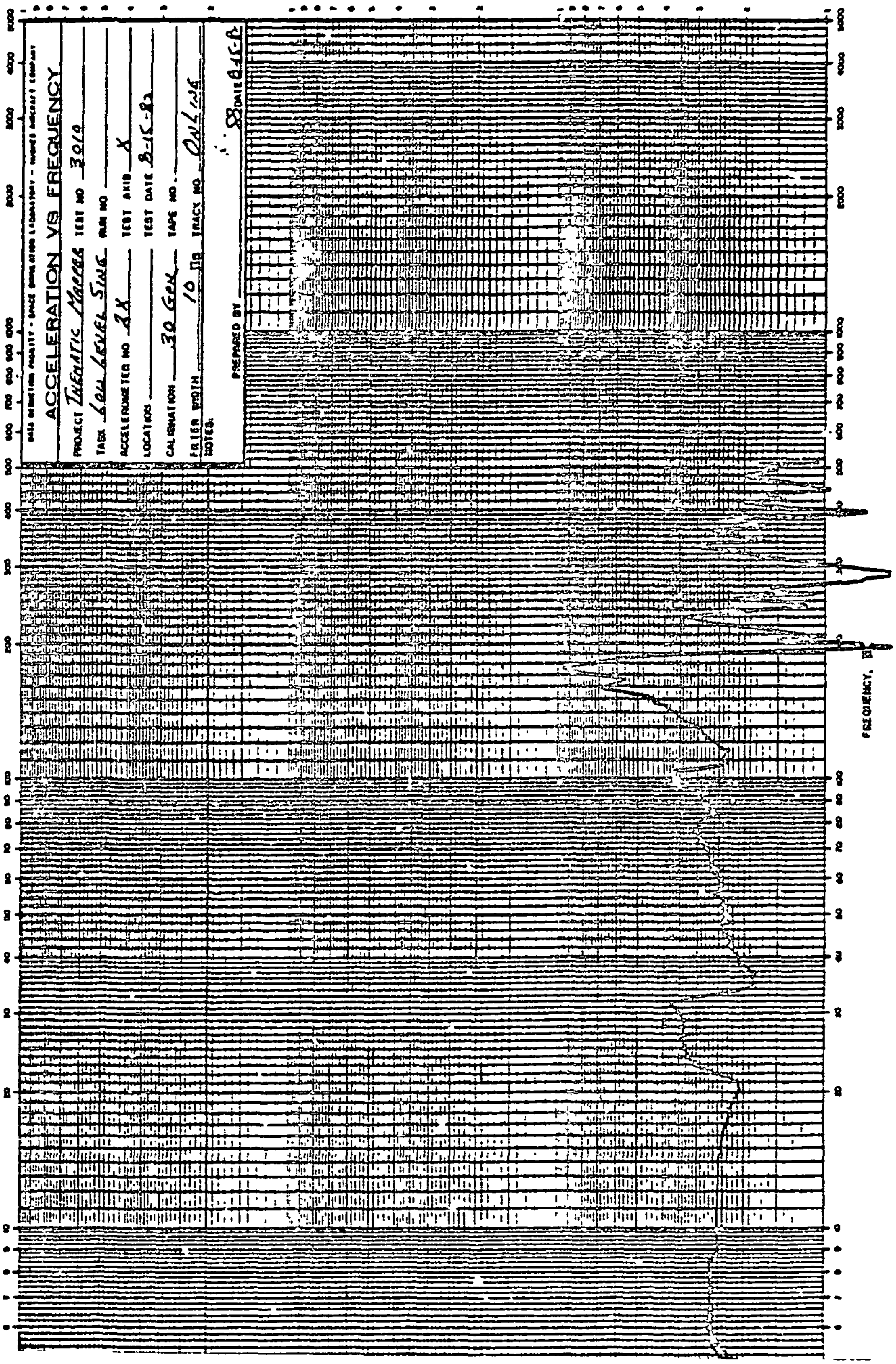

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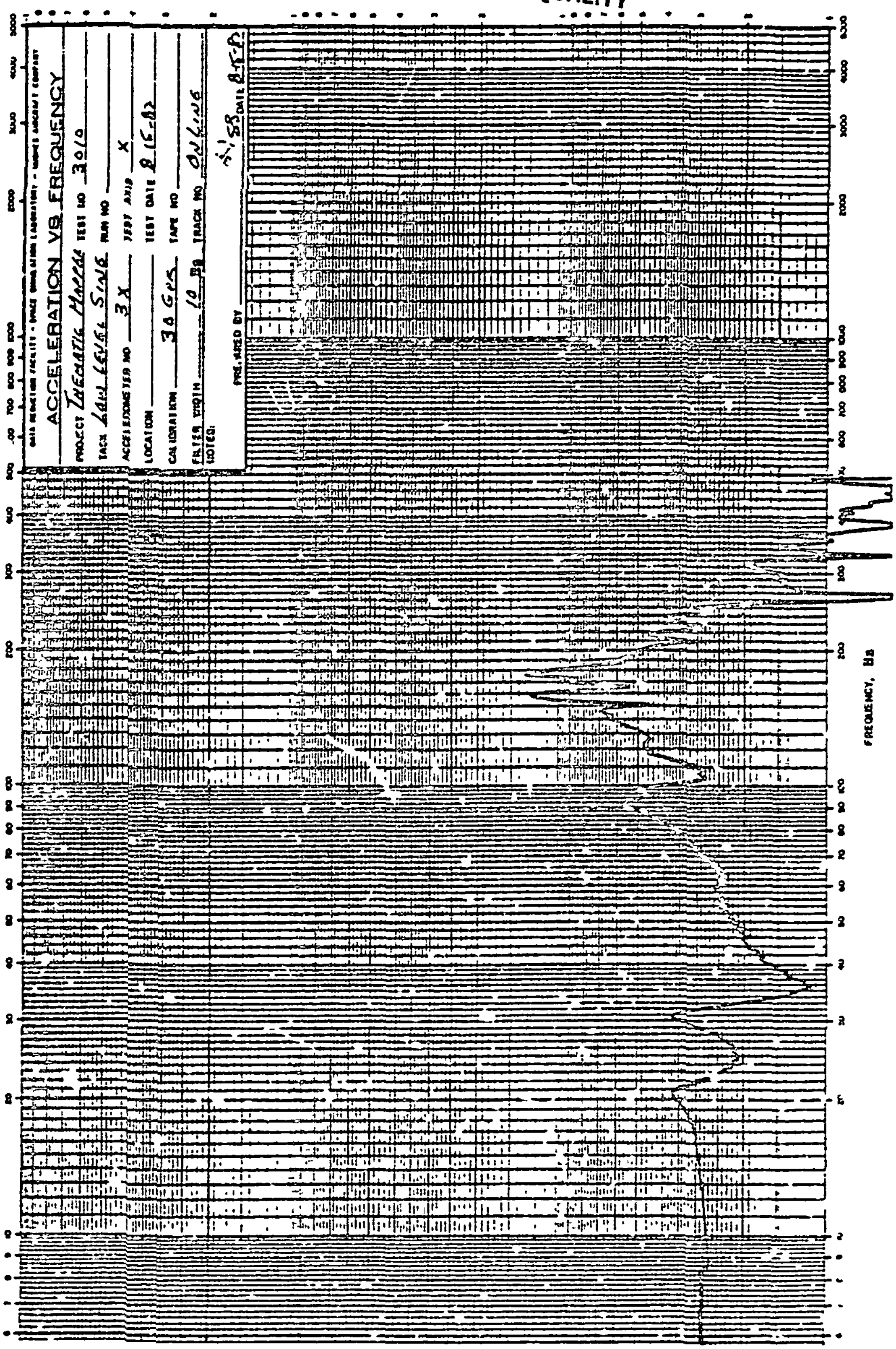

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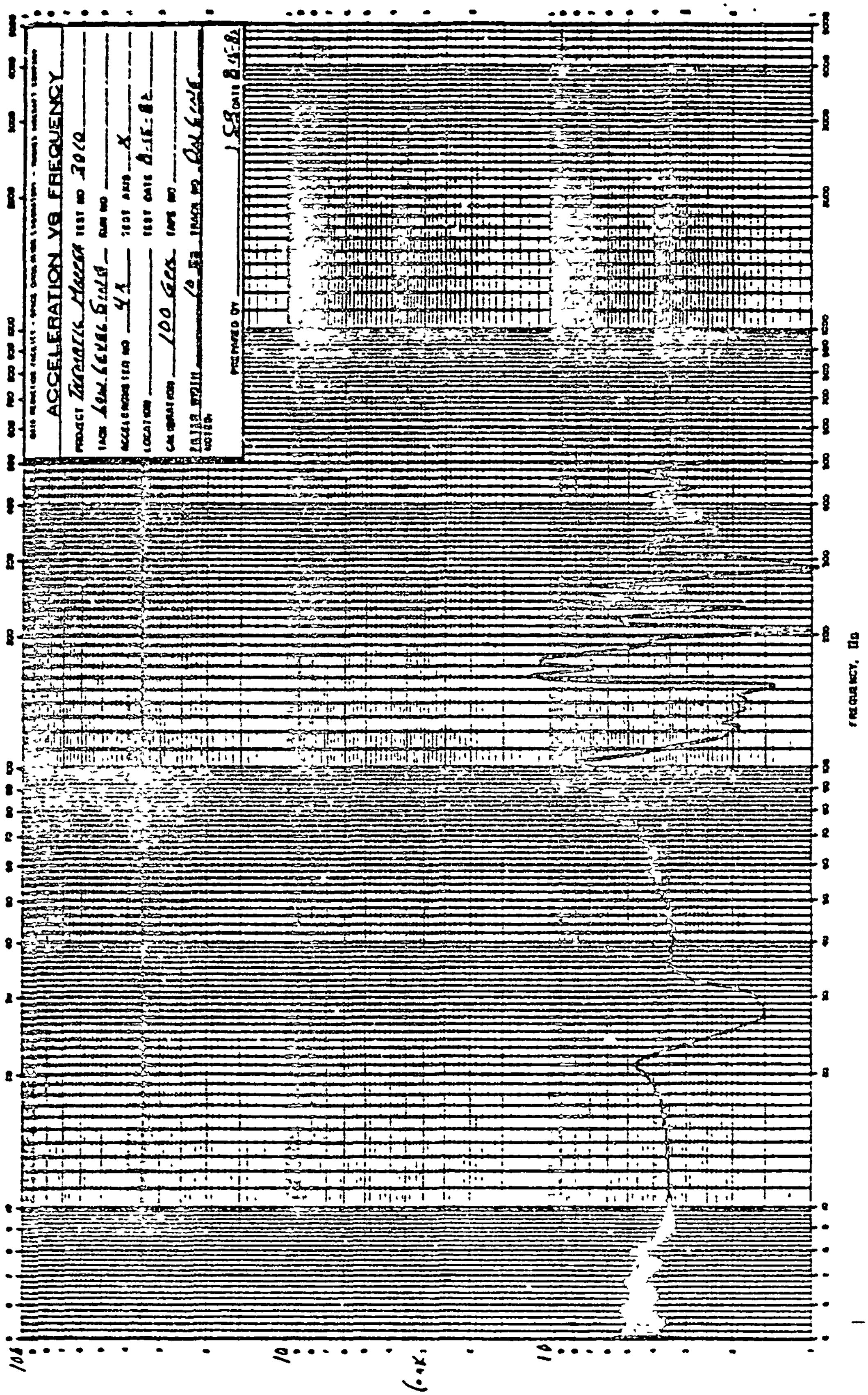

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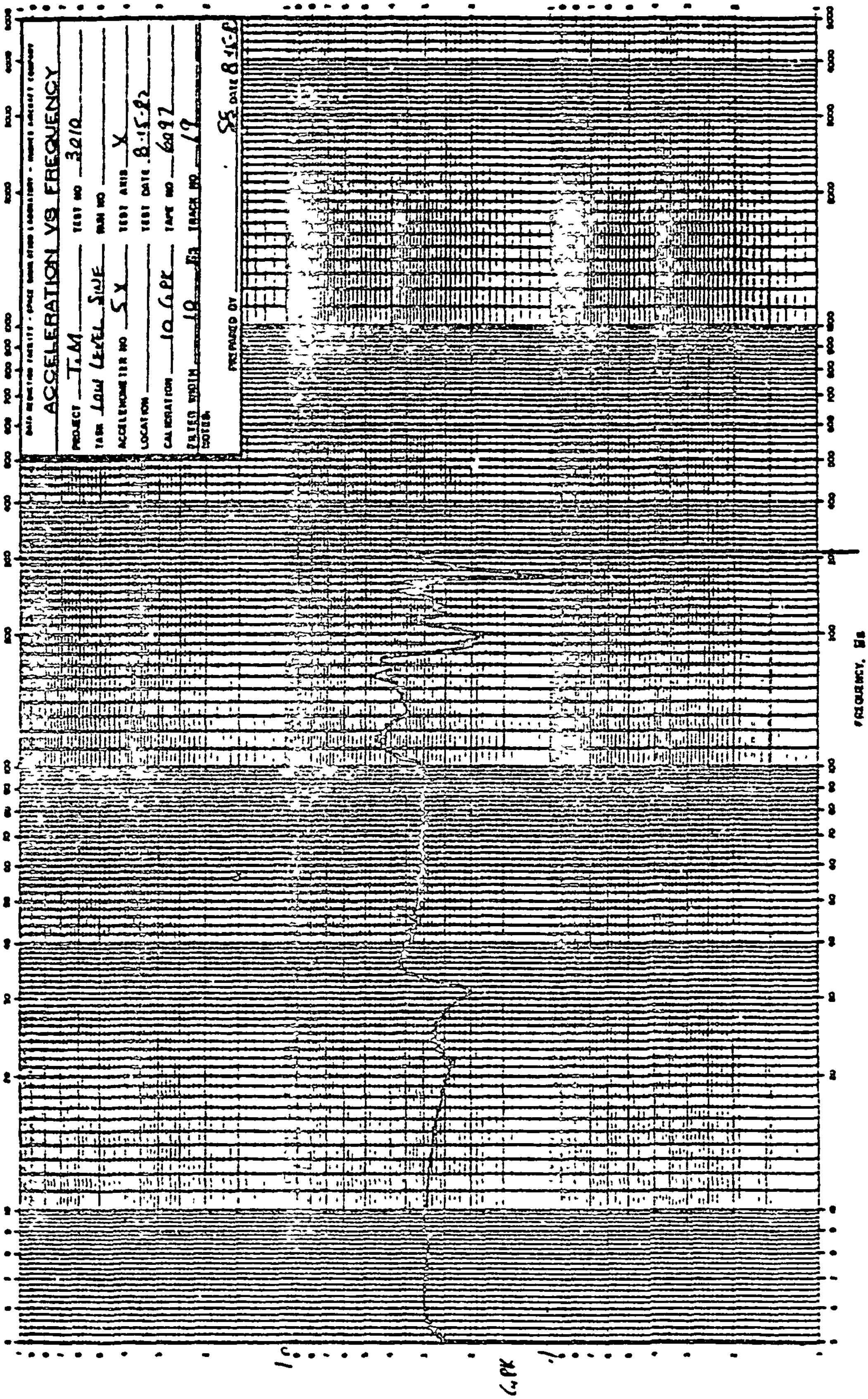

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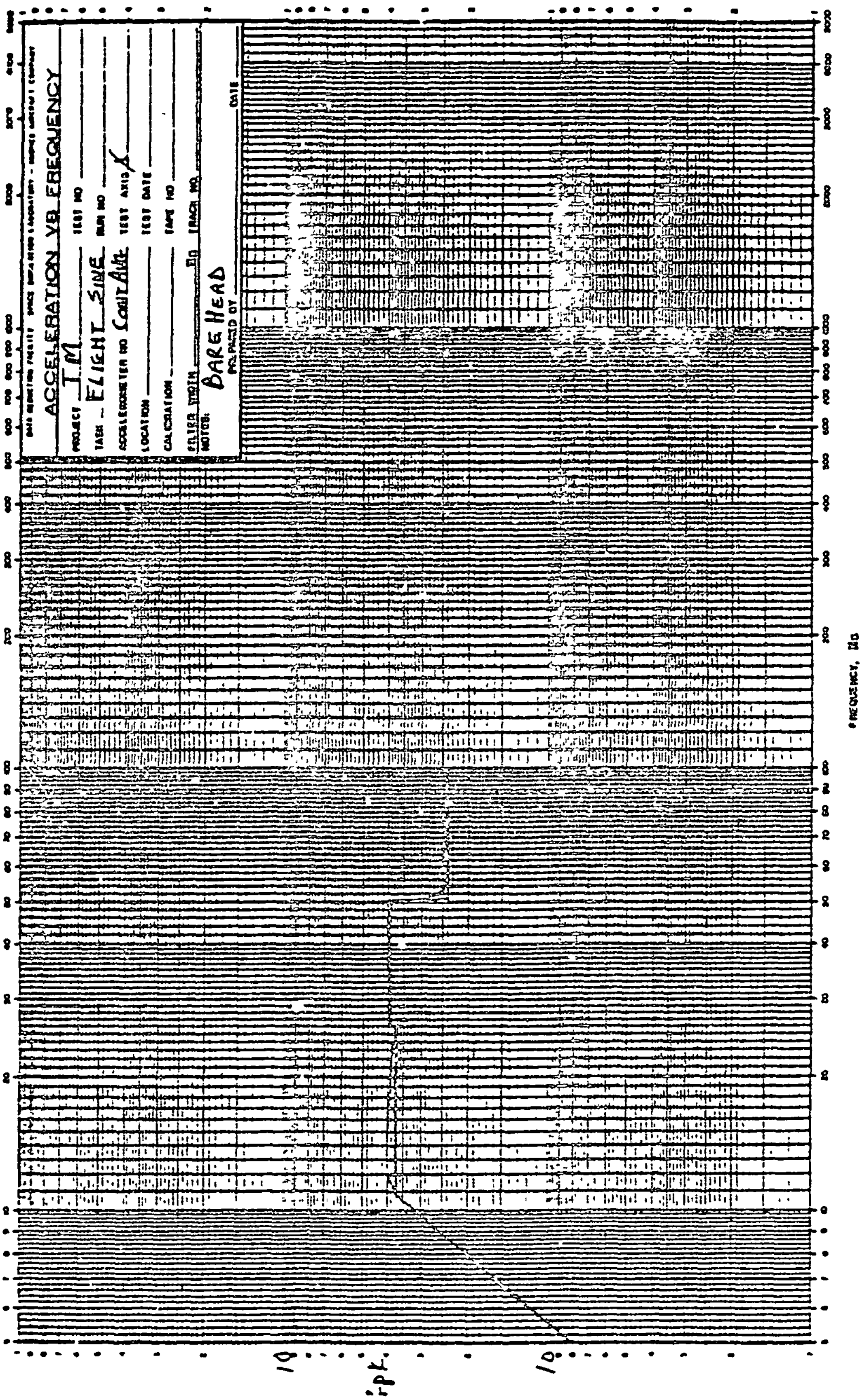

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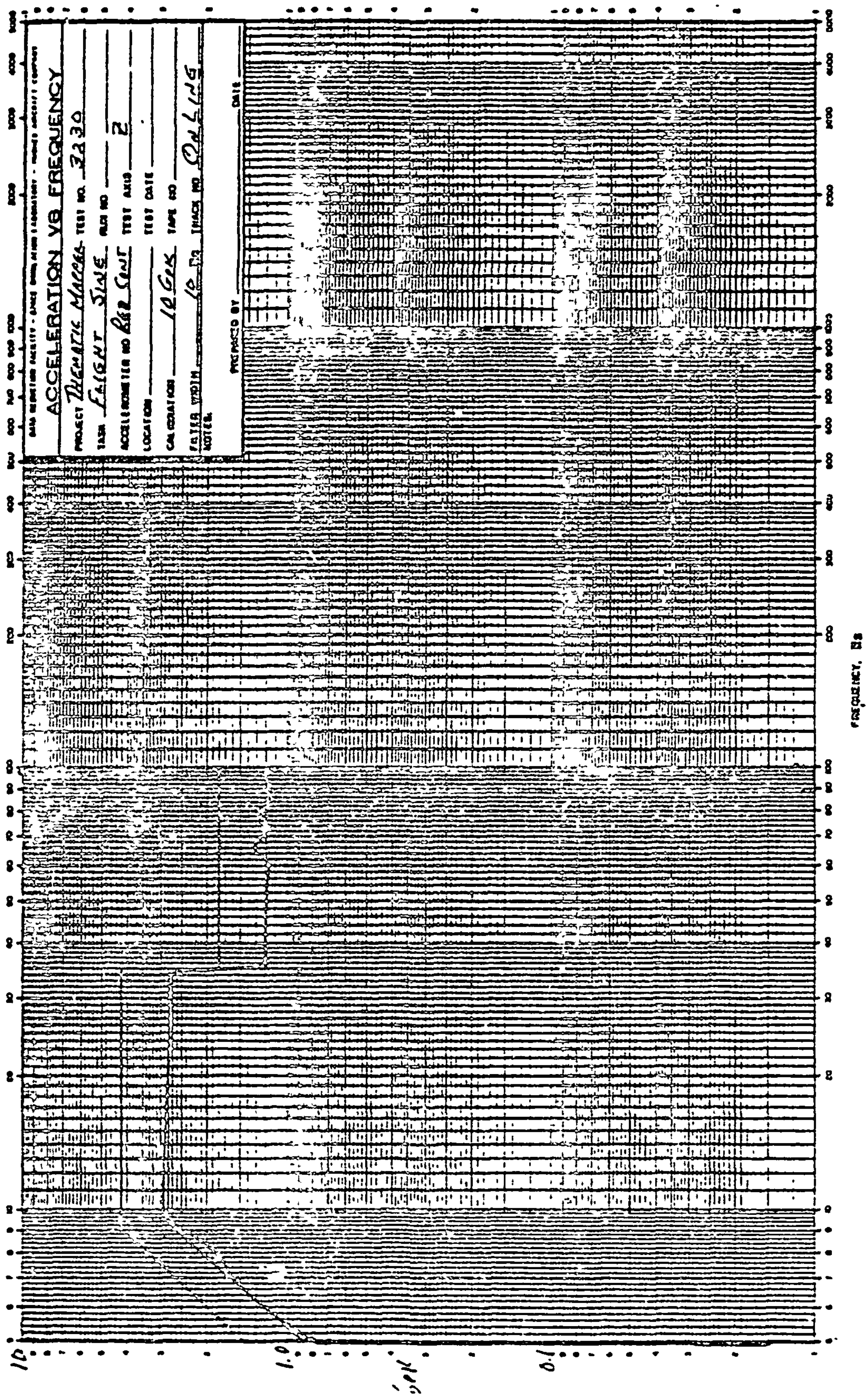

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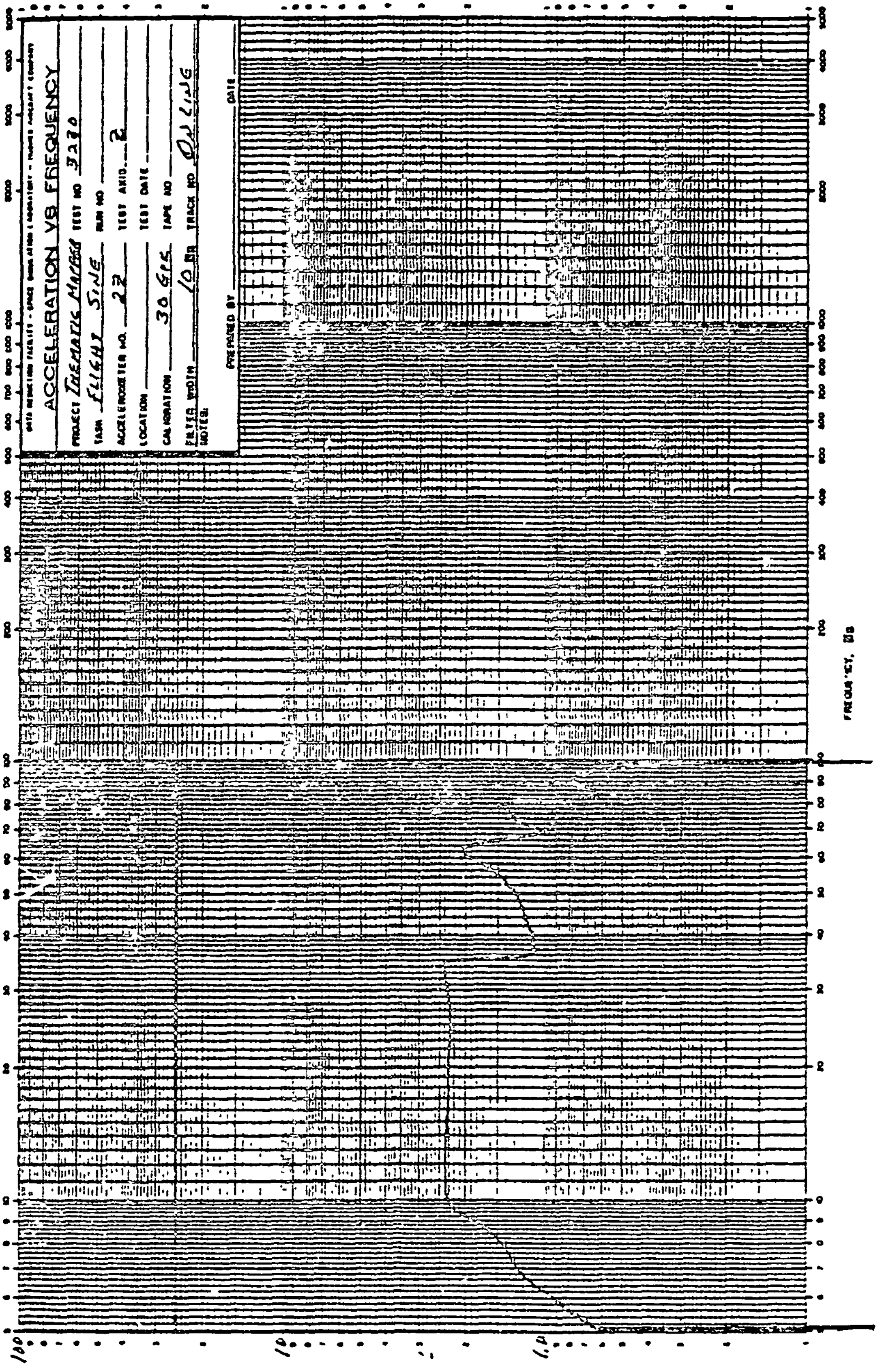

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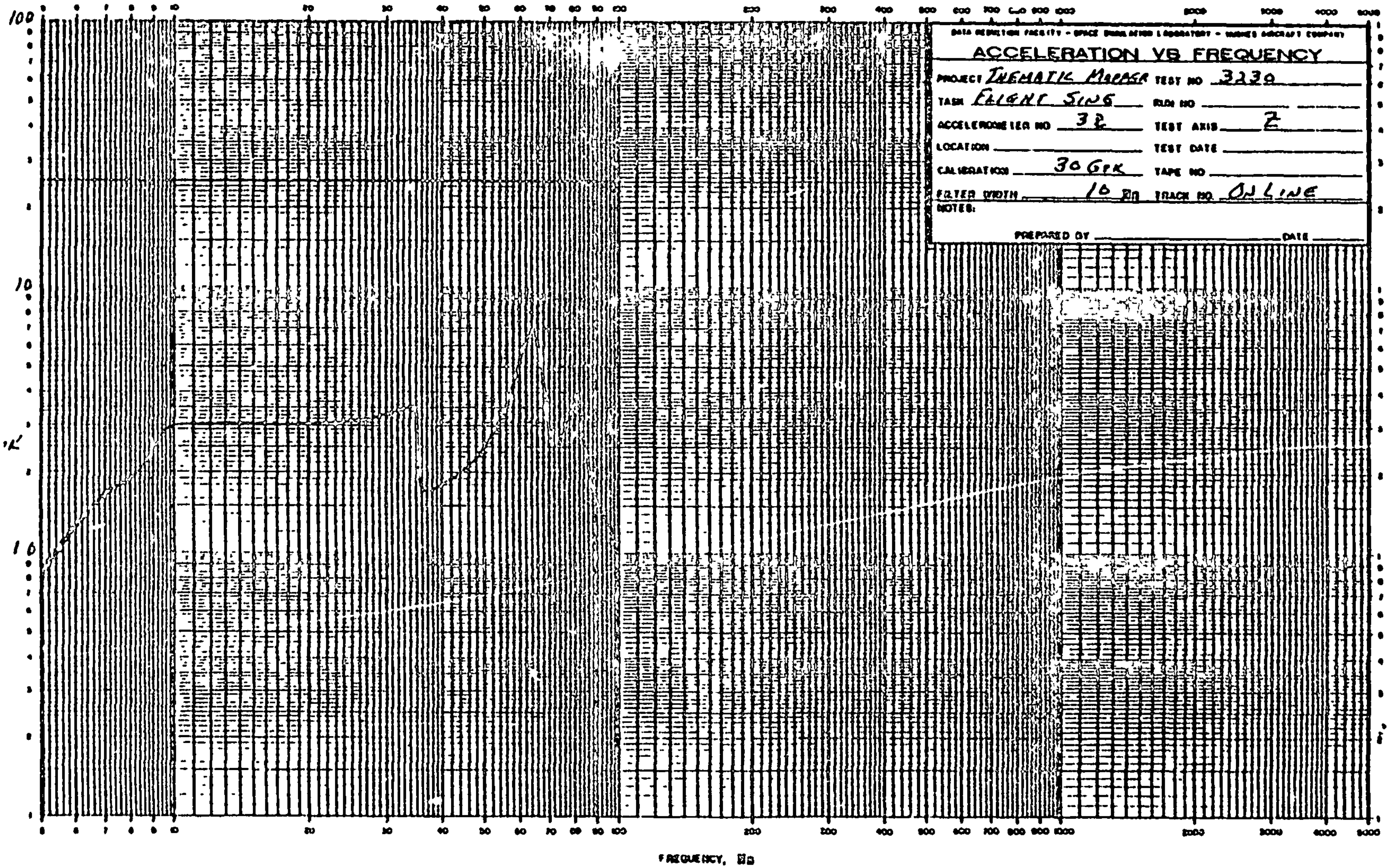

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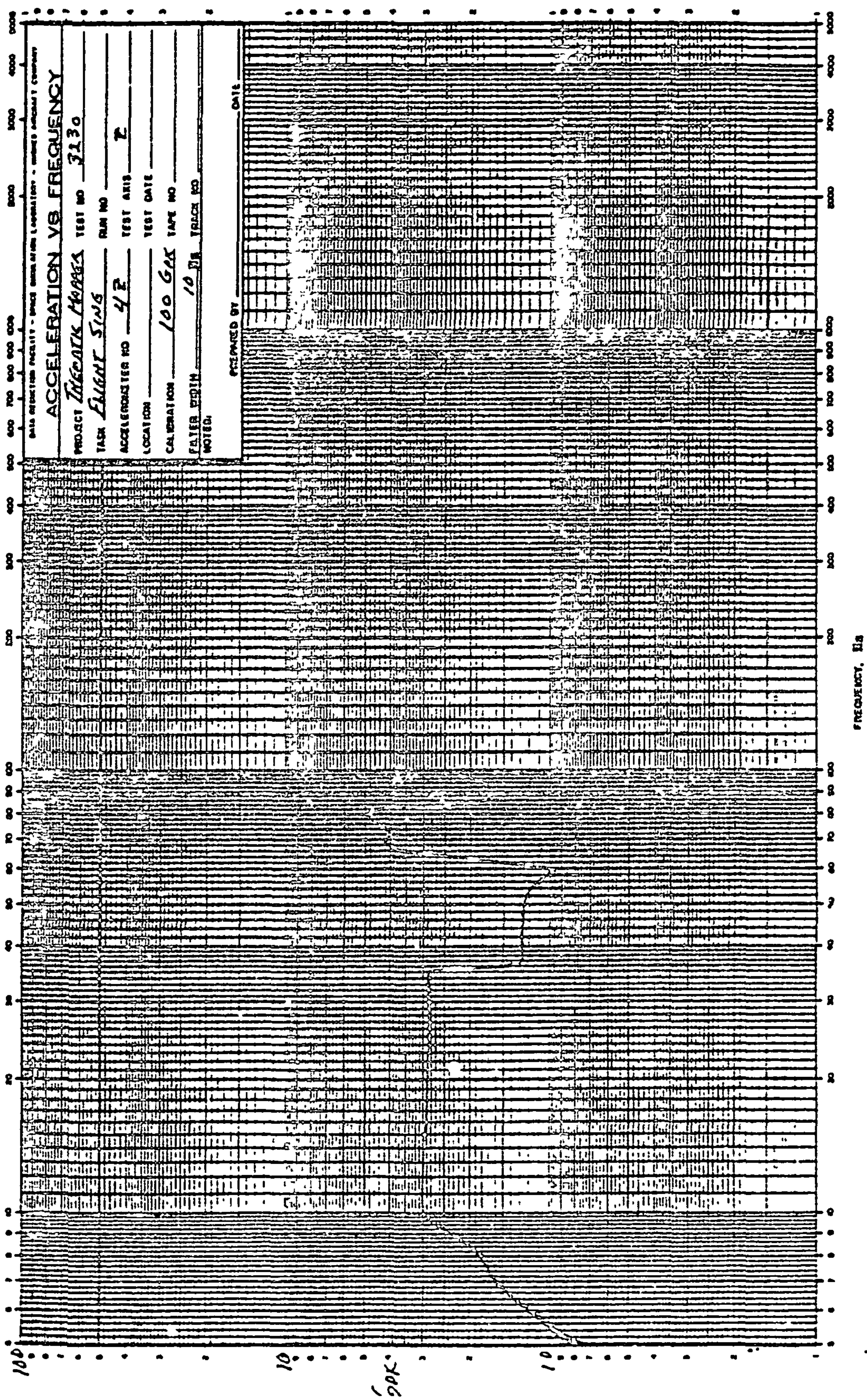

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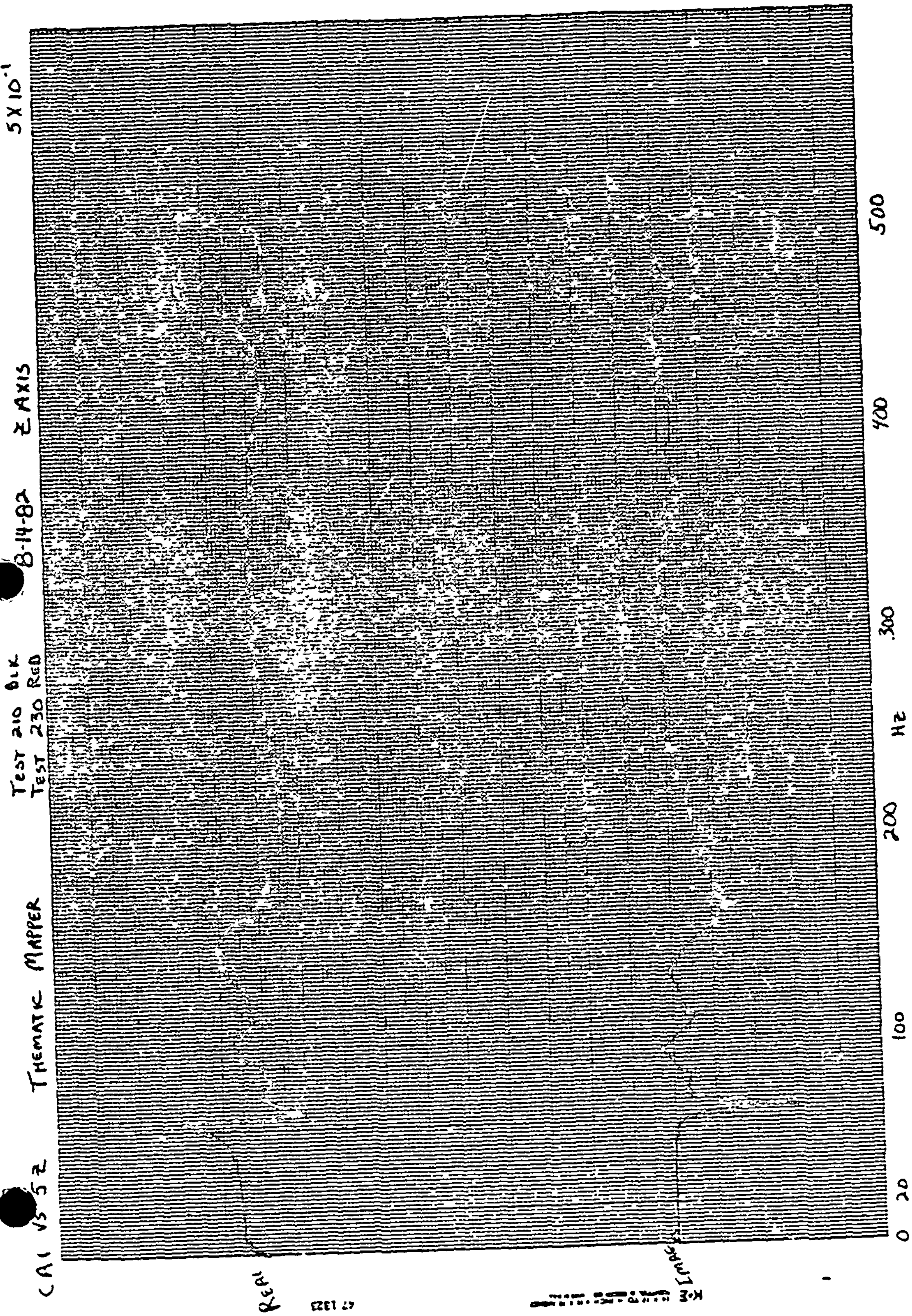

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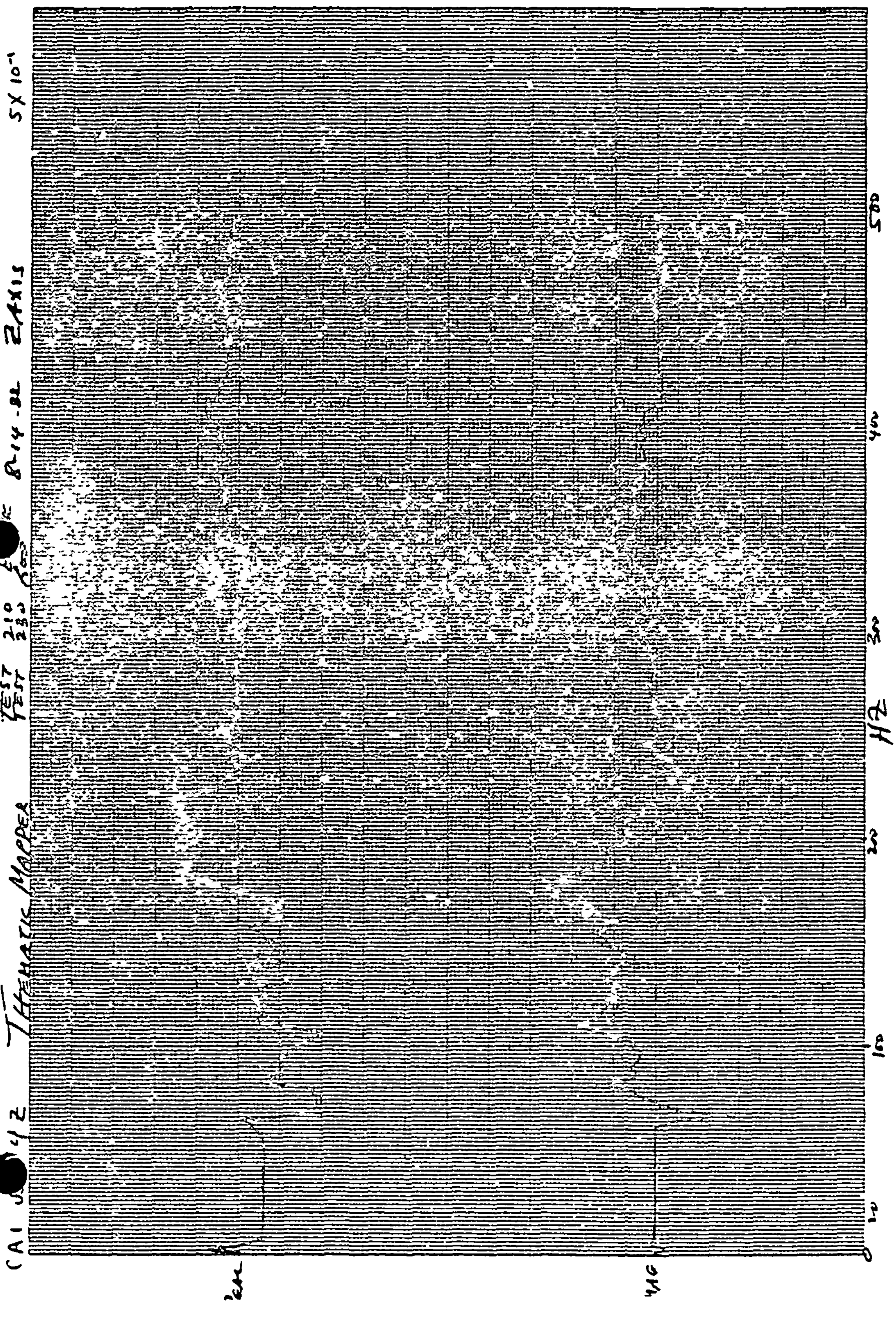

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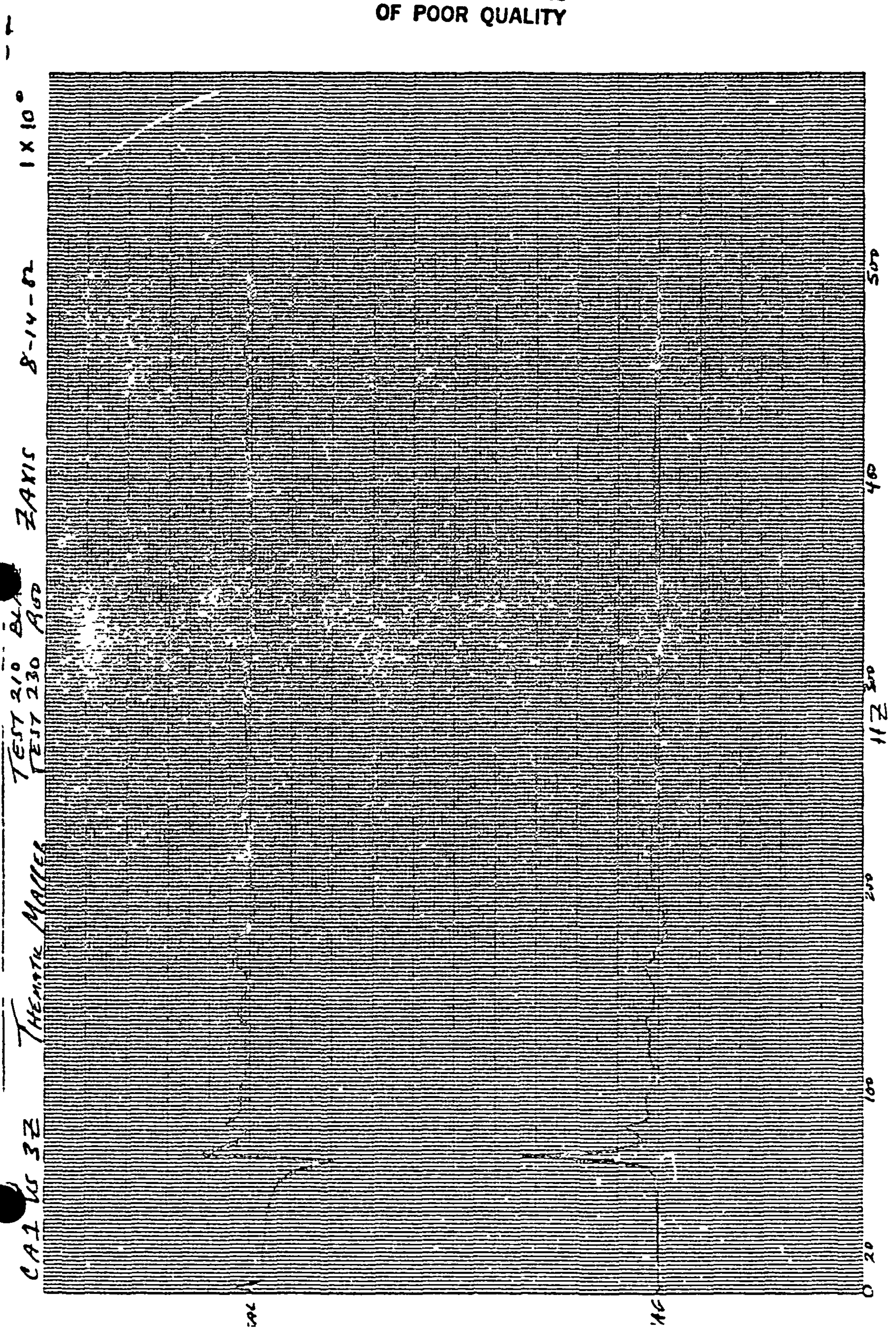

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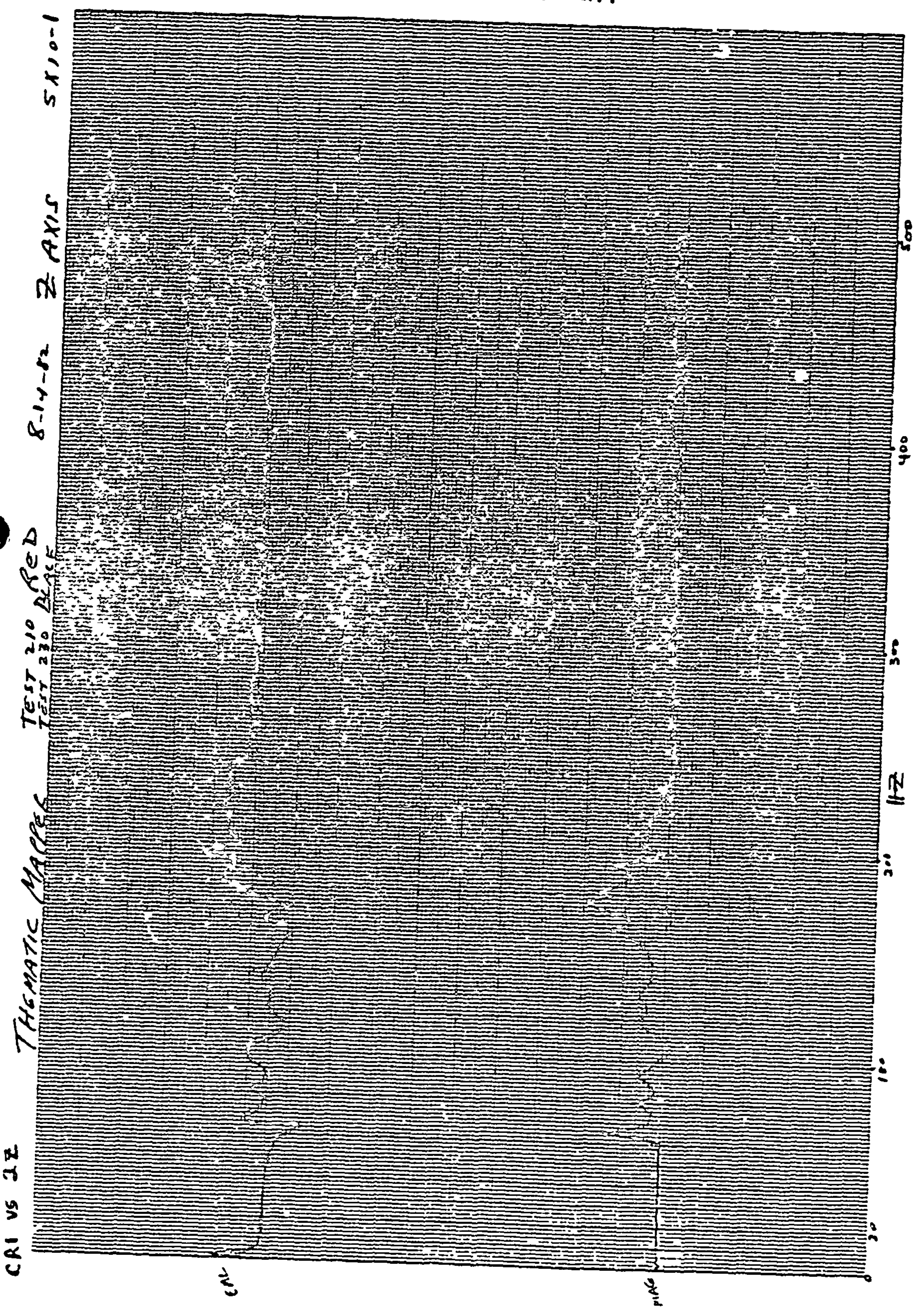

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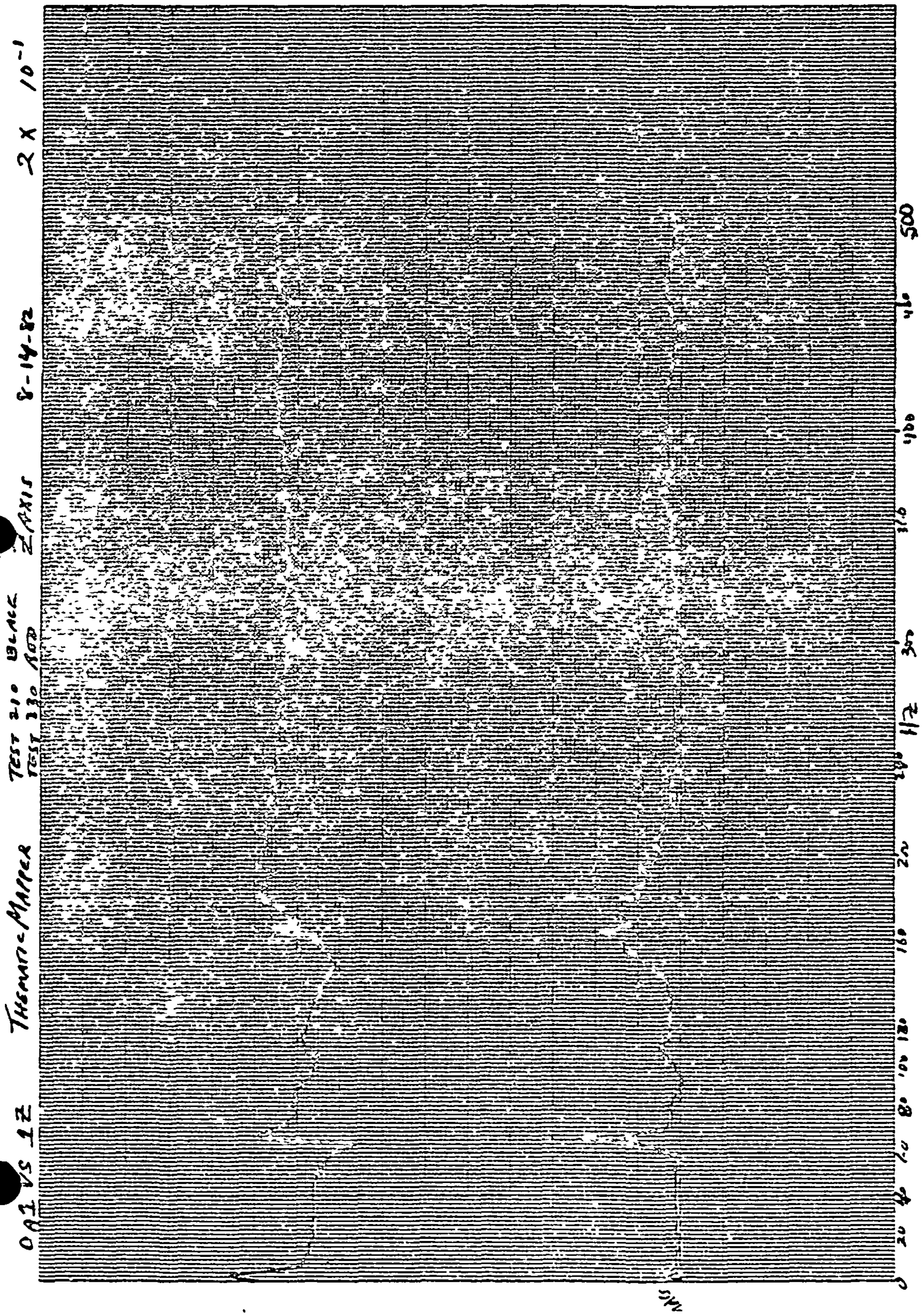

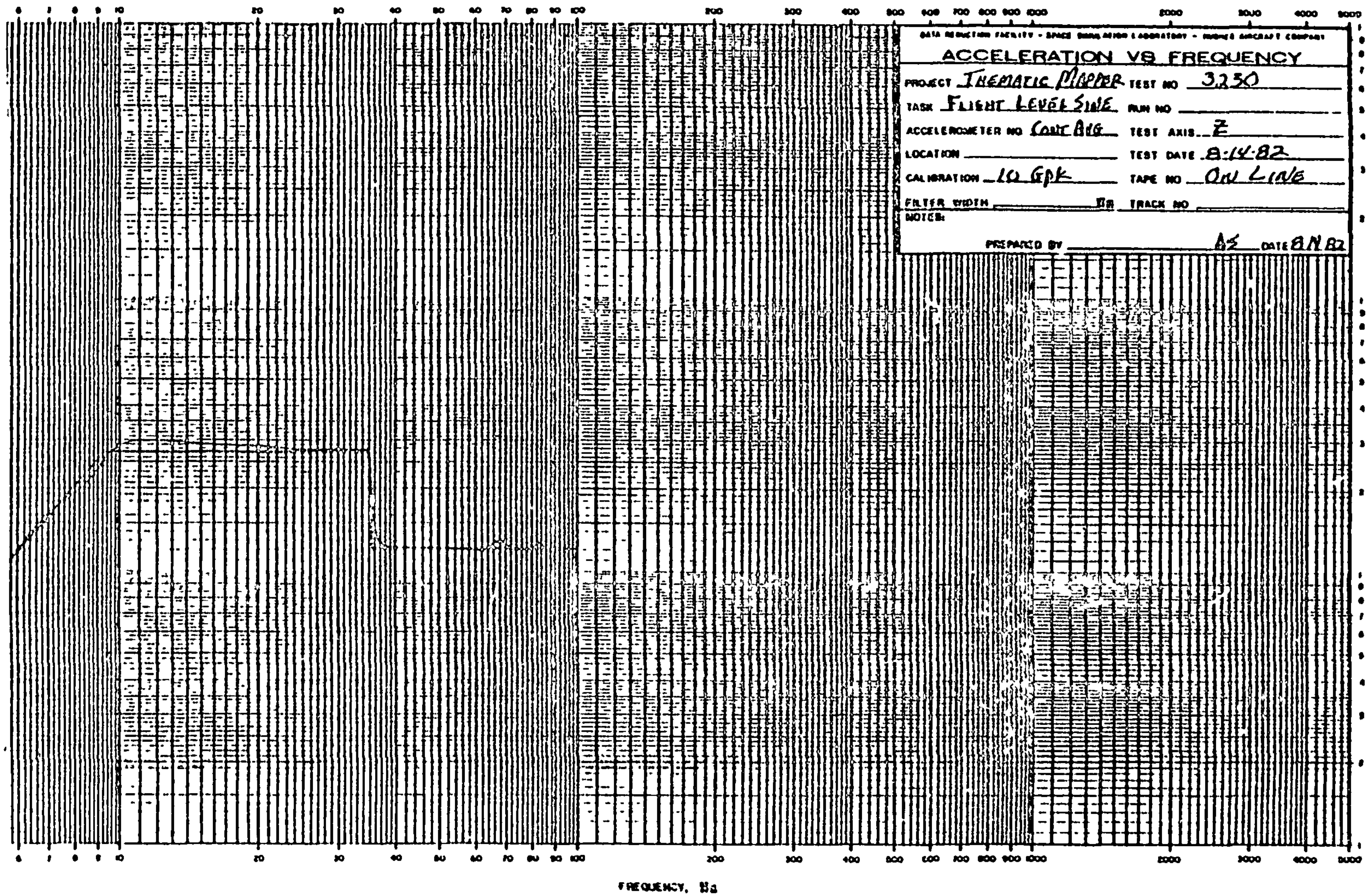
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ACCELERATION VS FREQUENCY
PROJECT Thematic Mapper TEST NO 3230
TASK Flight Level Sine RUN NO
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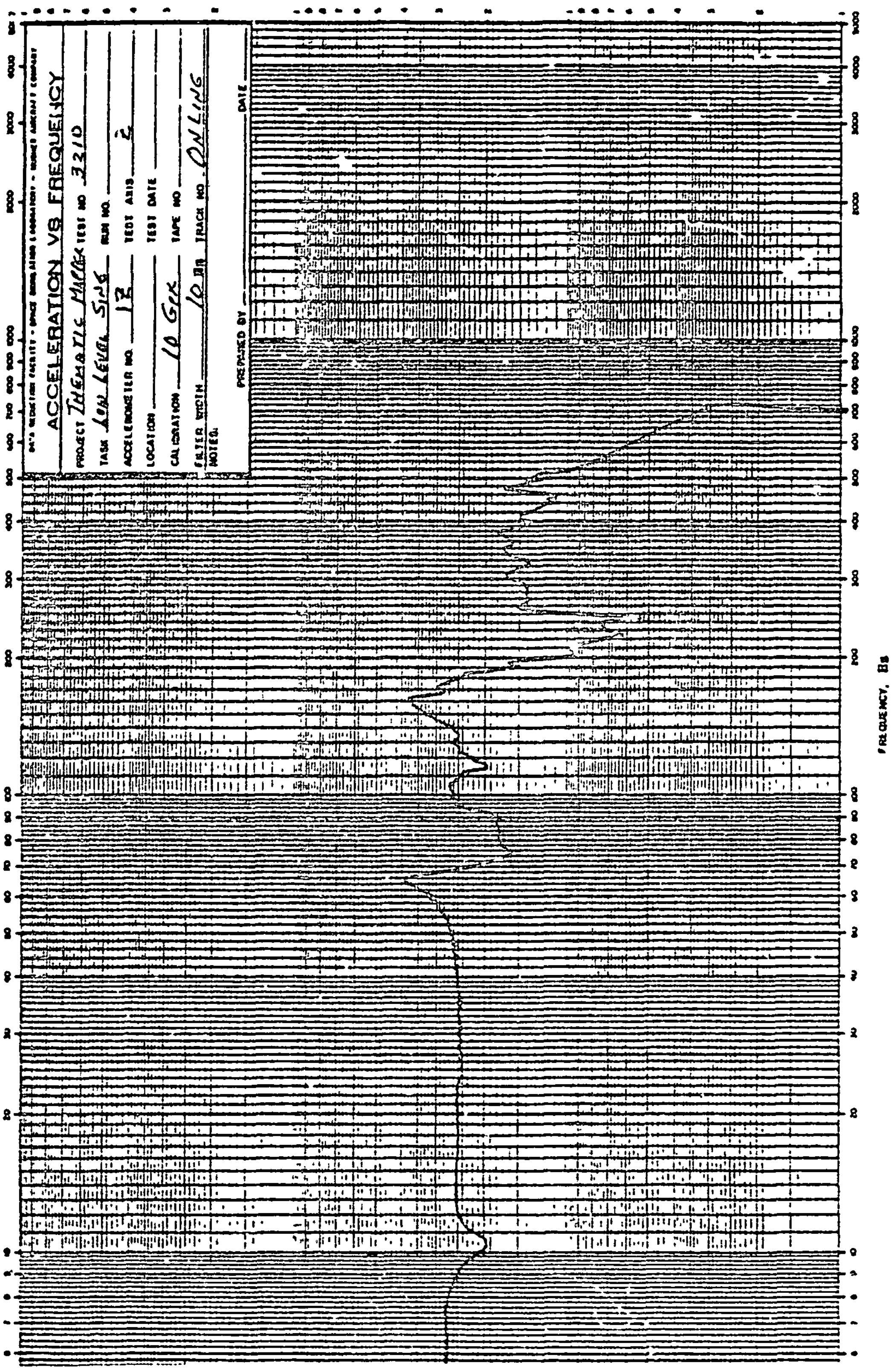

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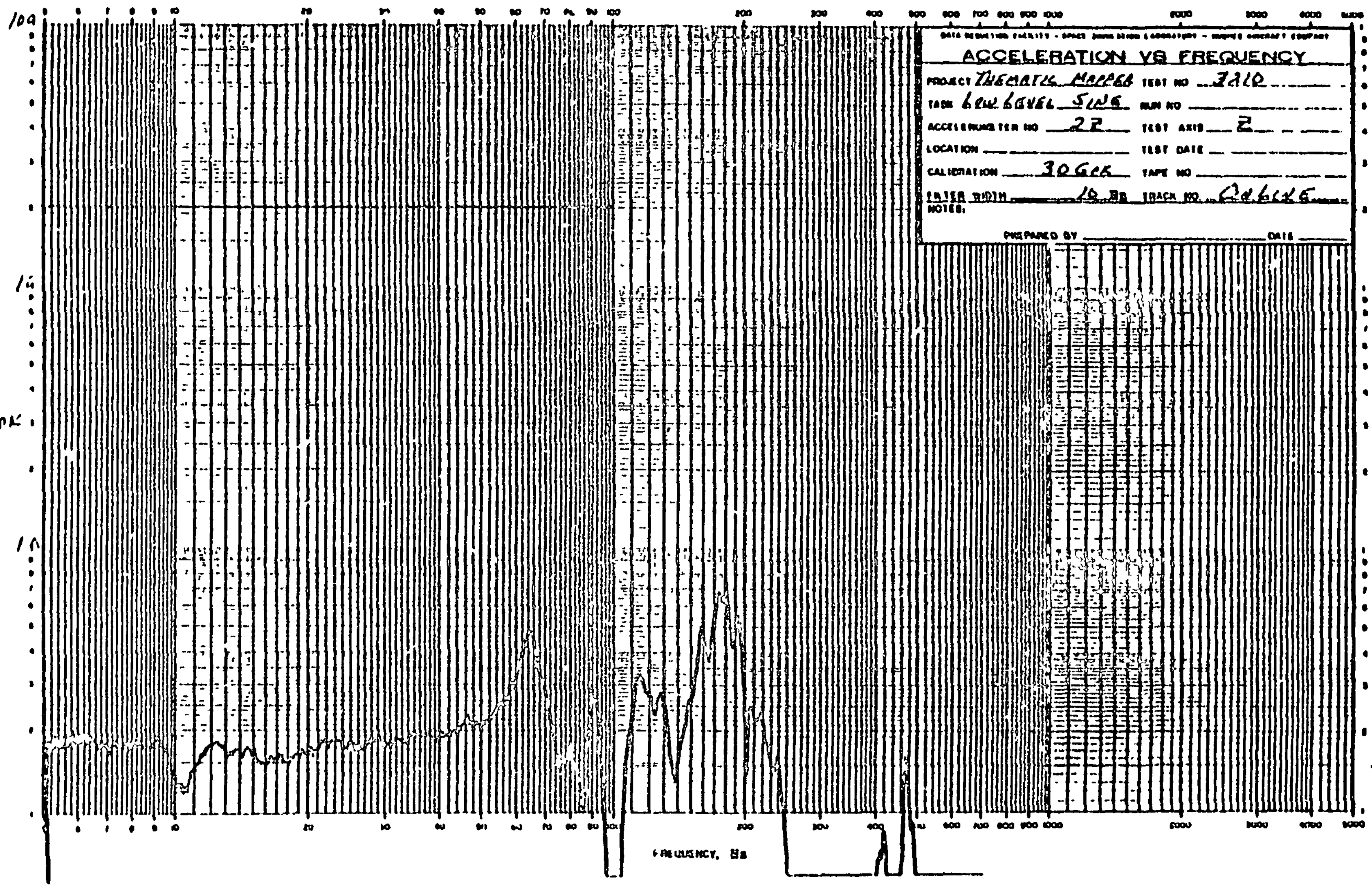

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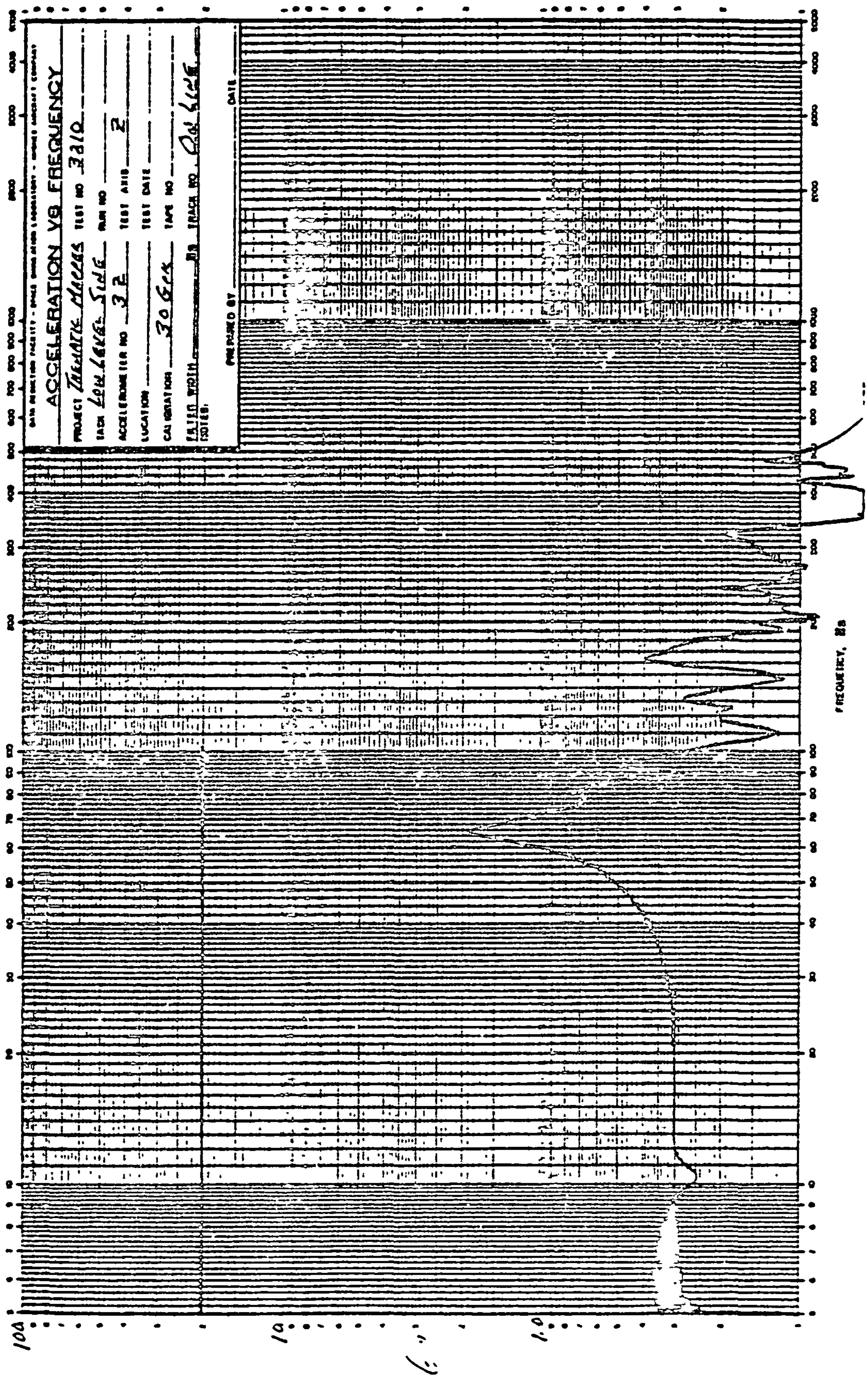

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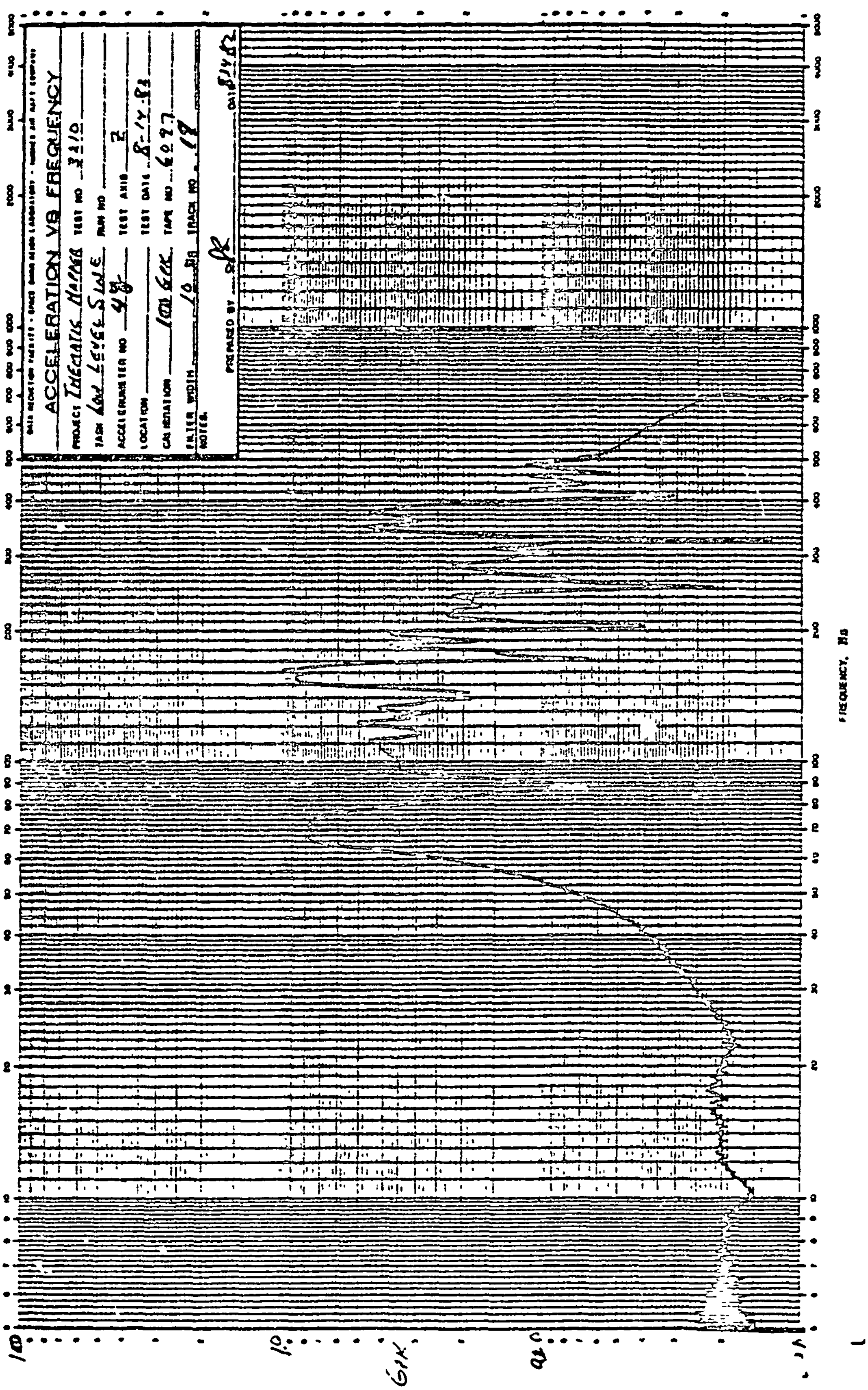

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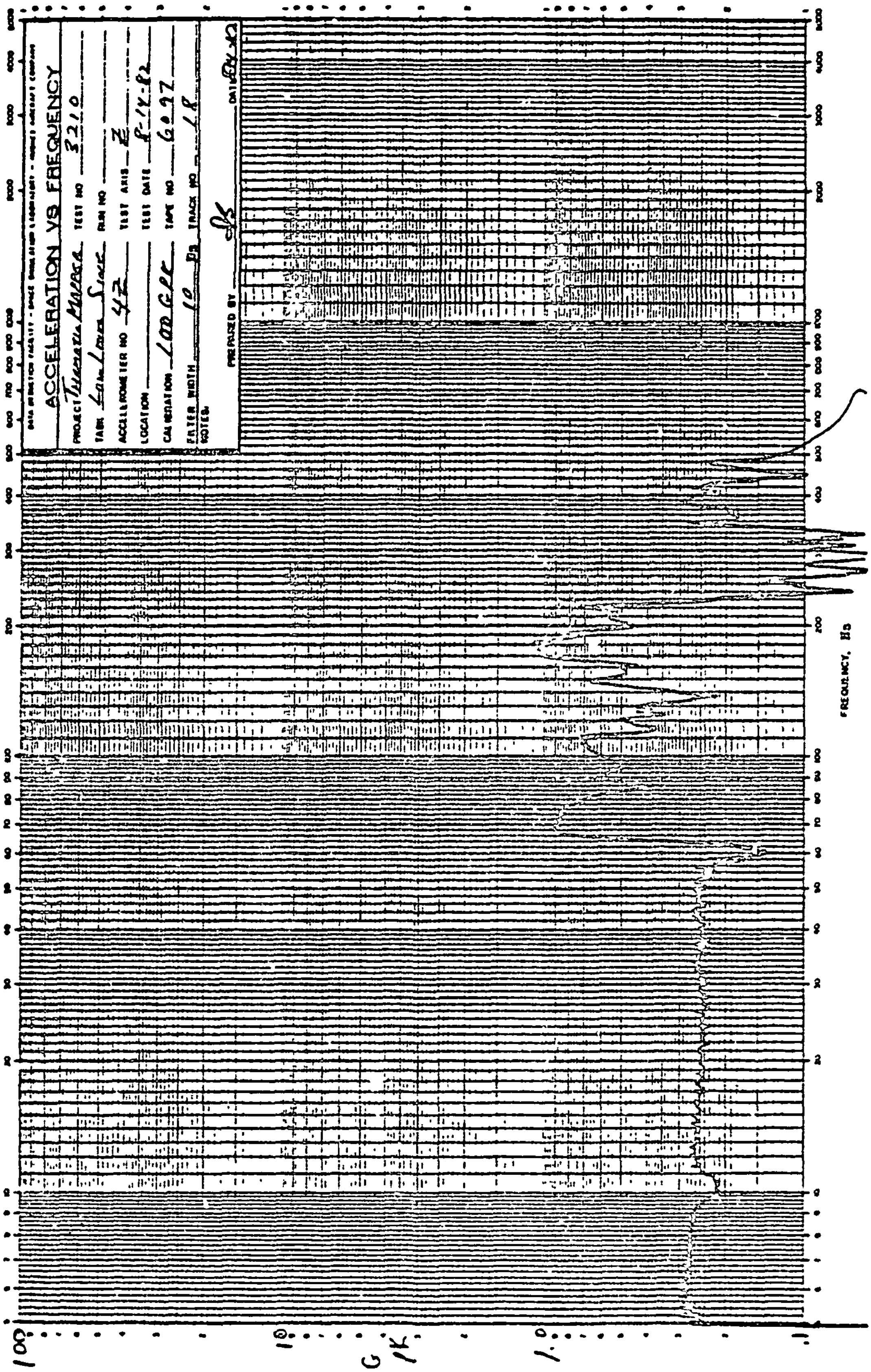

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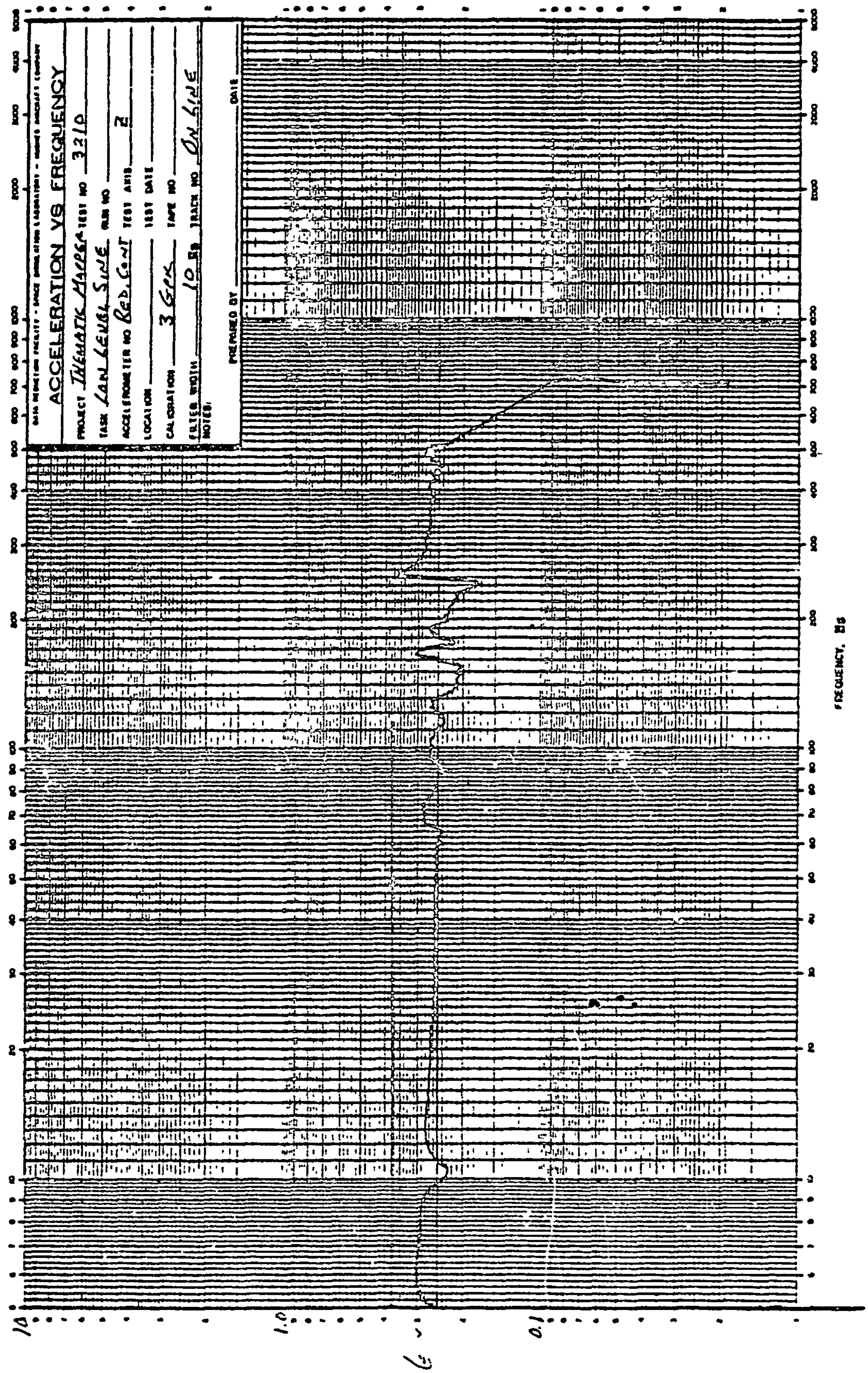

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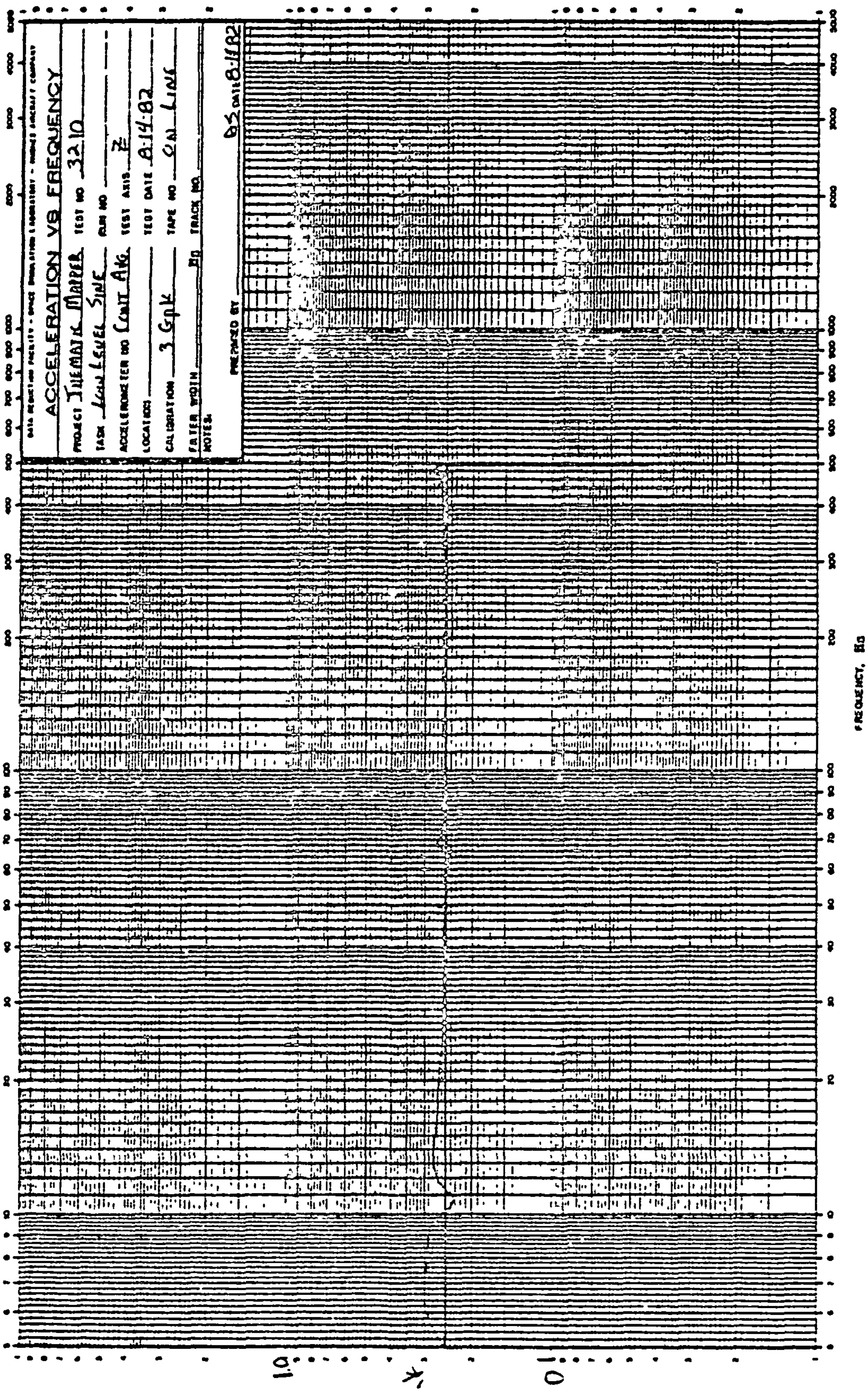

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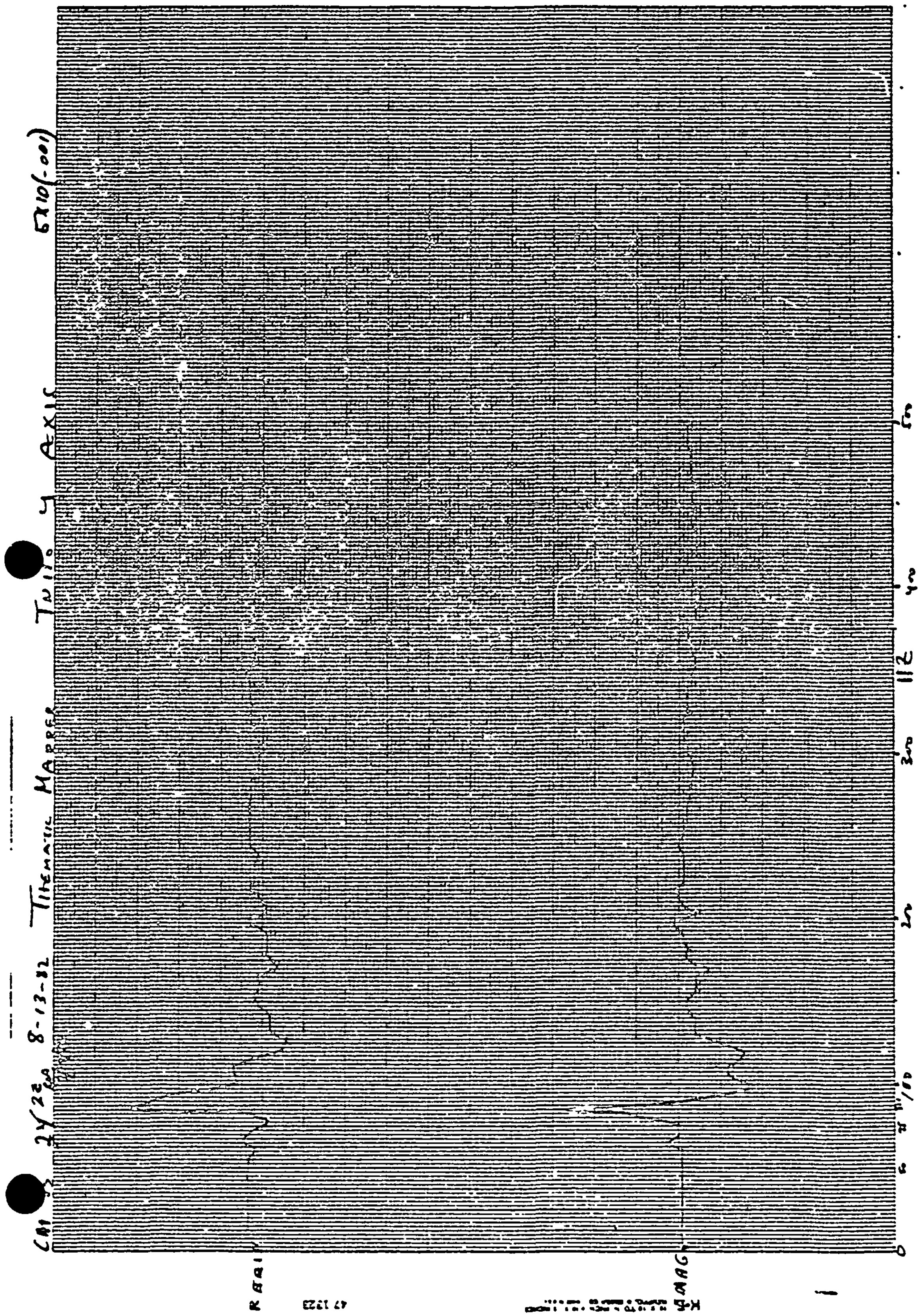

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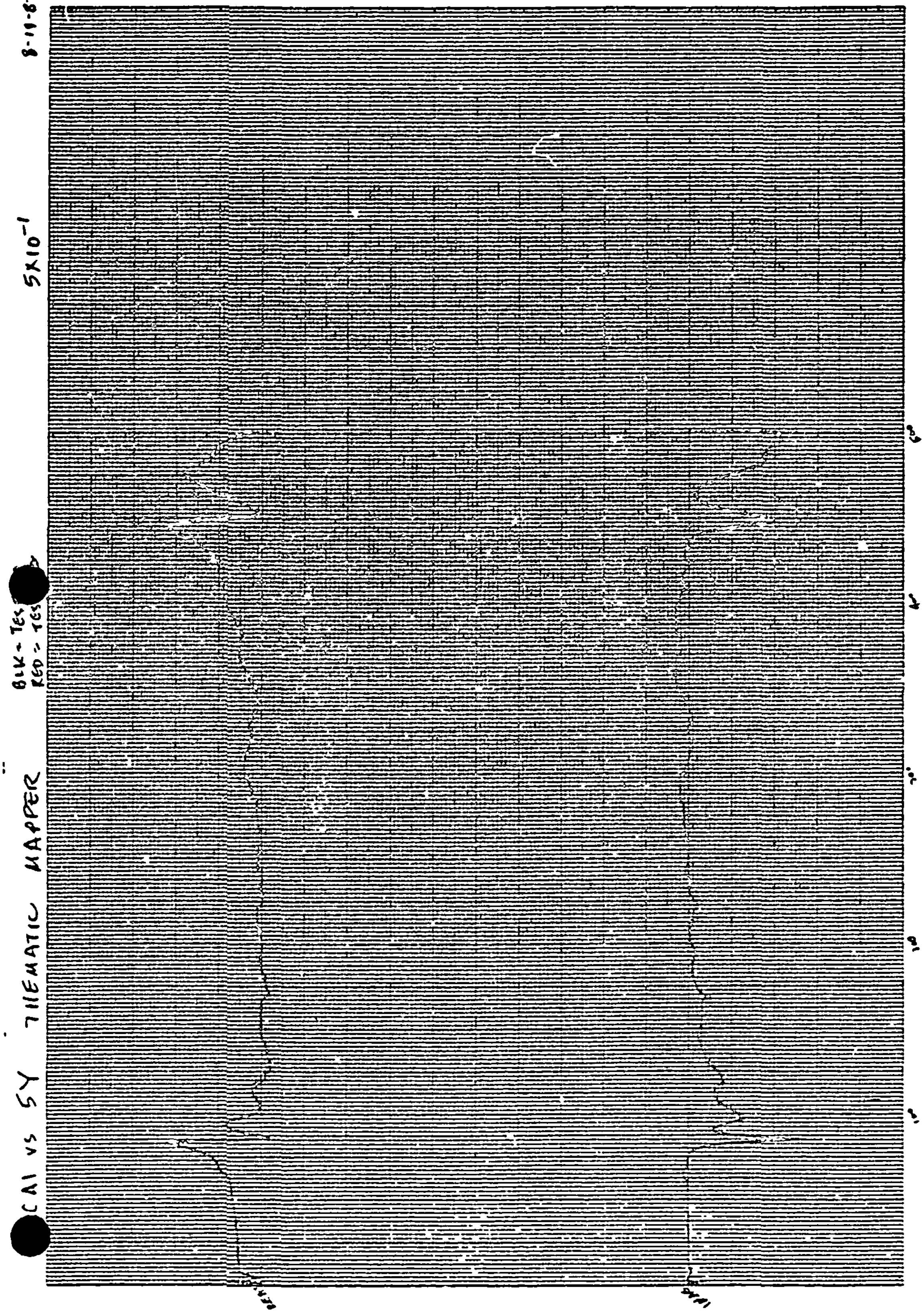

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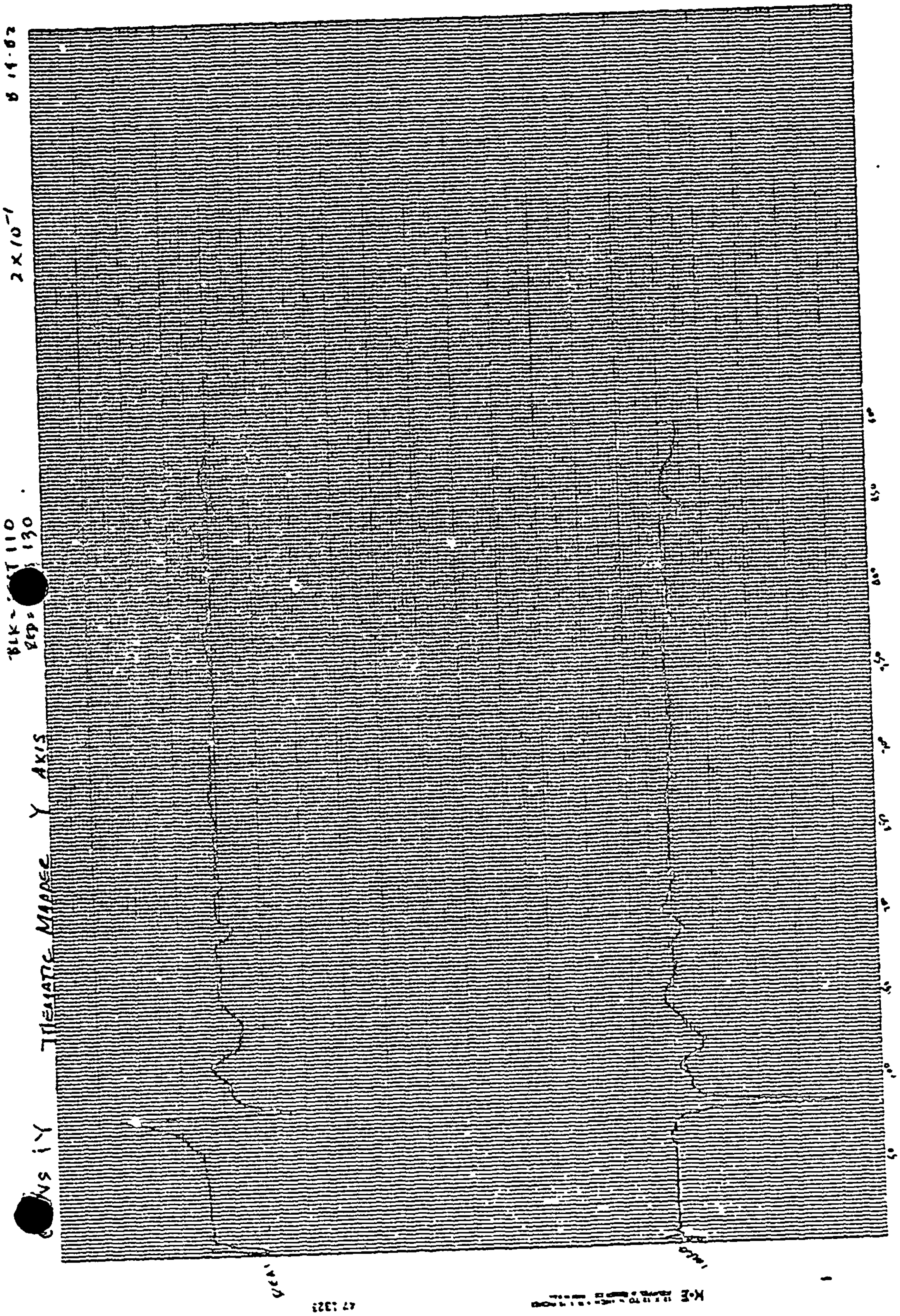

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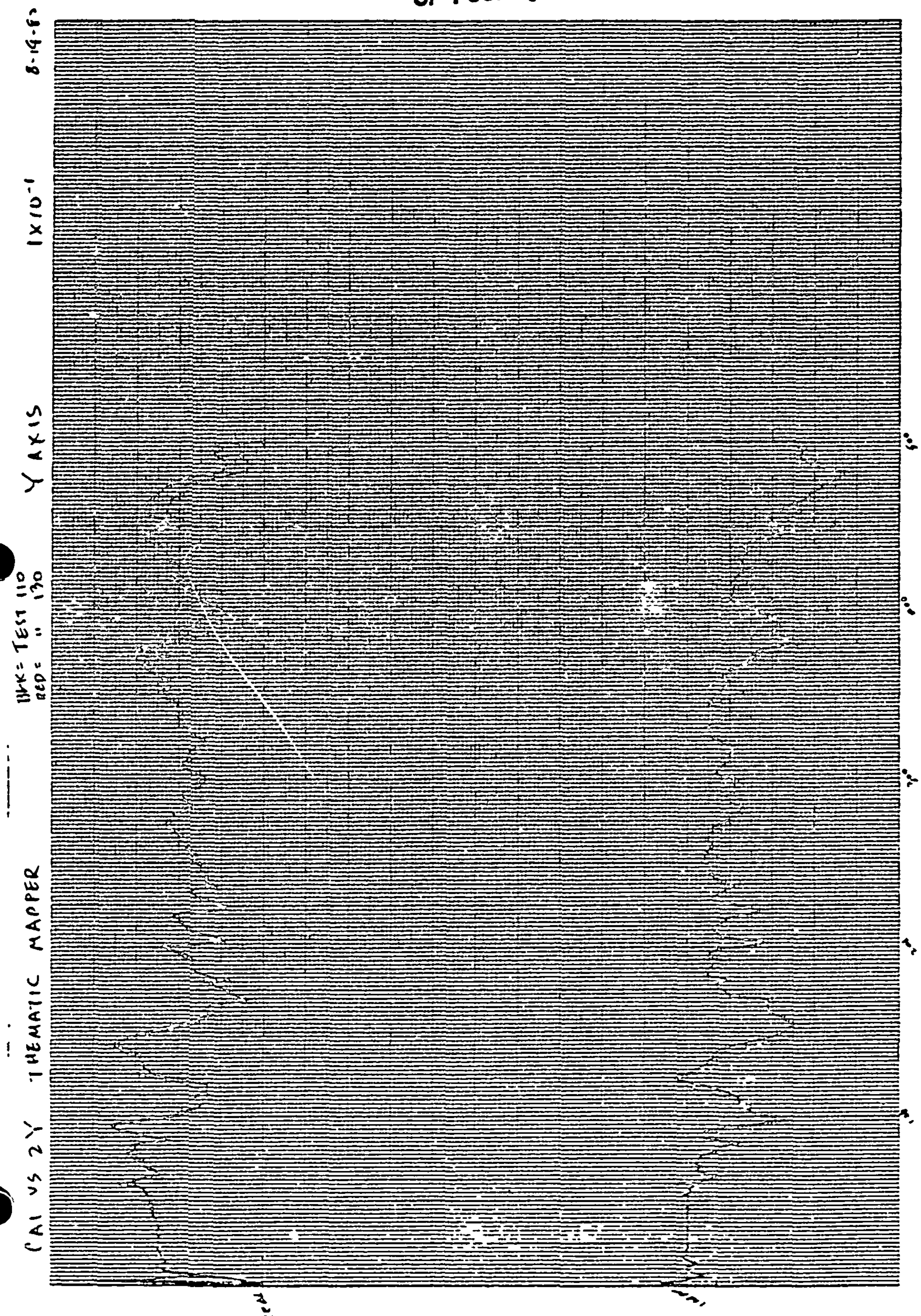

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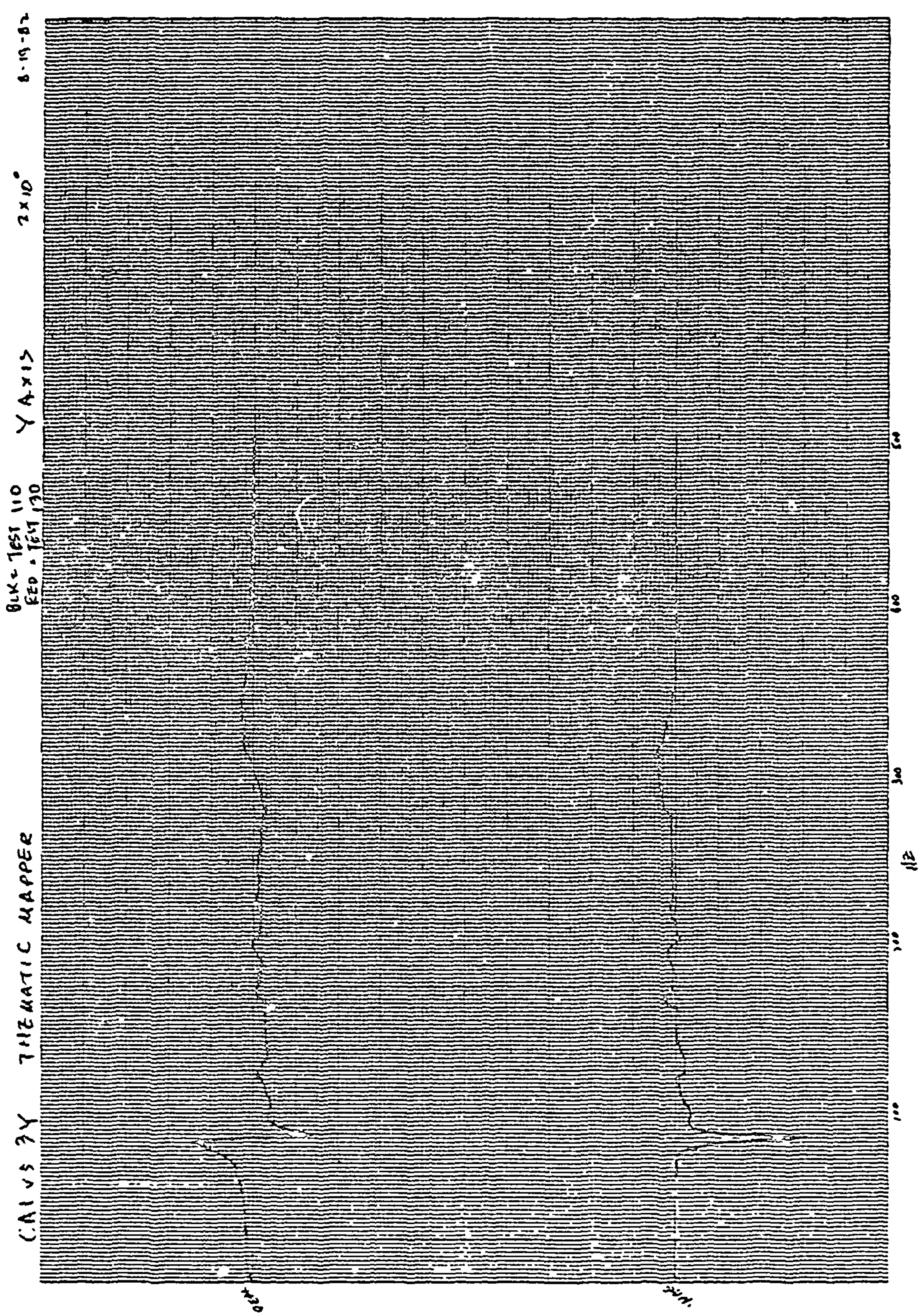

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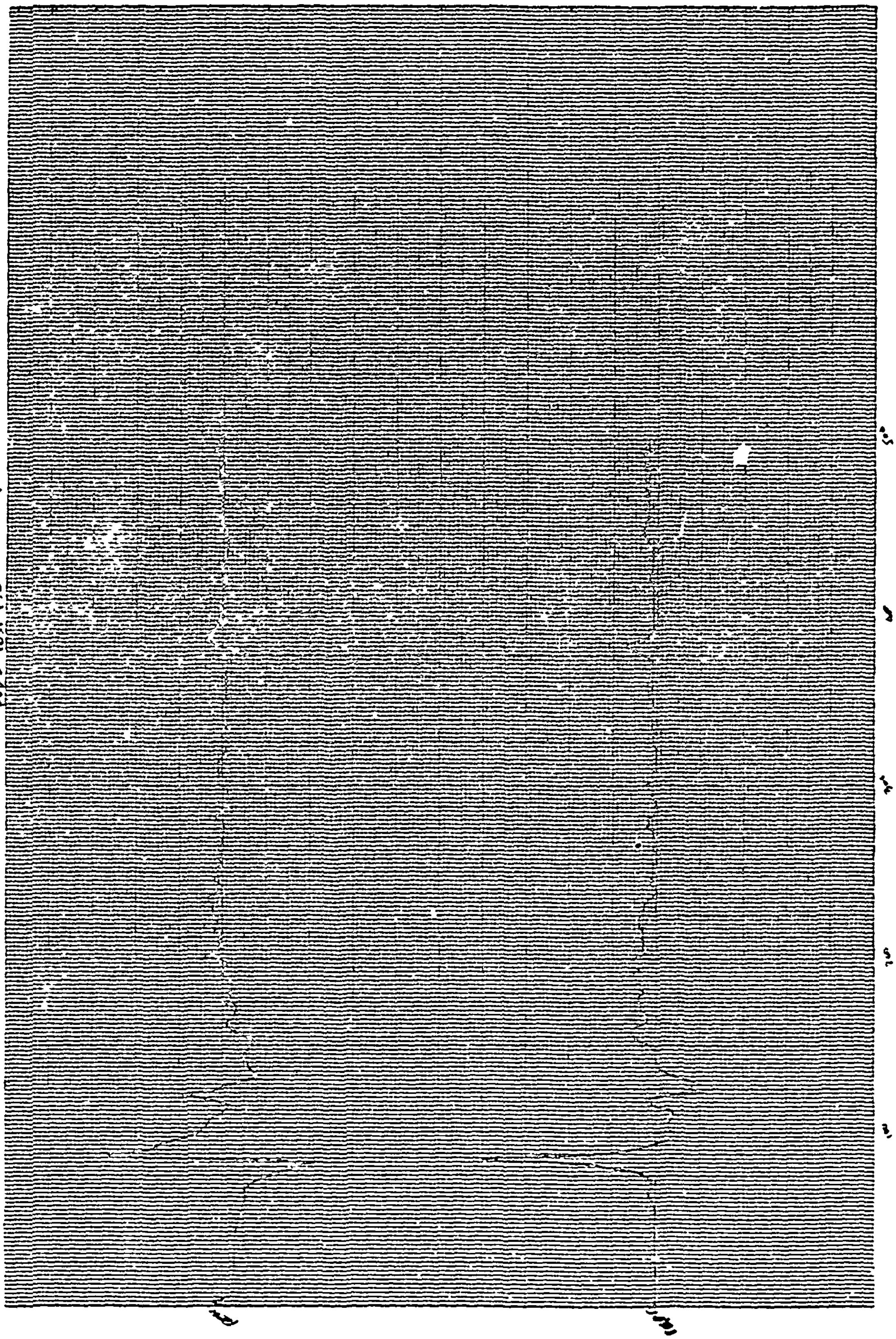
BLK = TEST 110
RED = TEST 130



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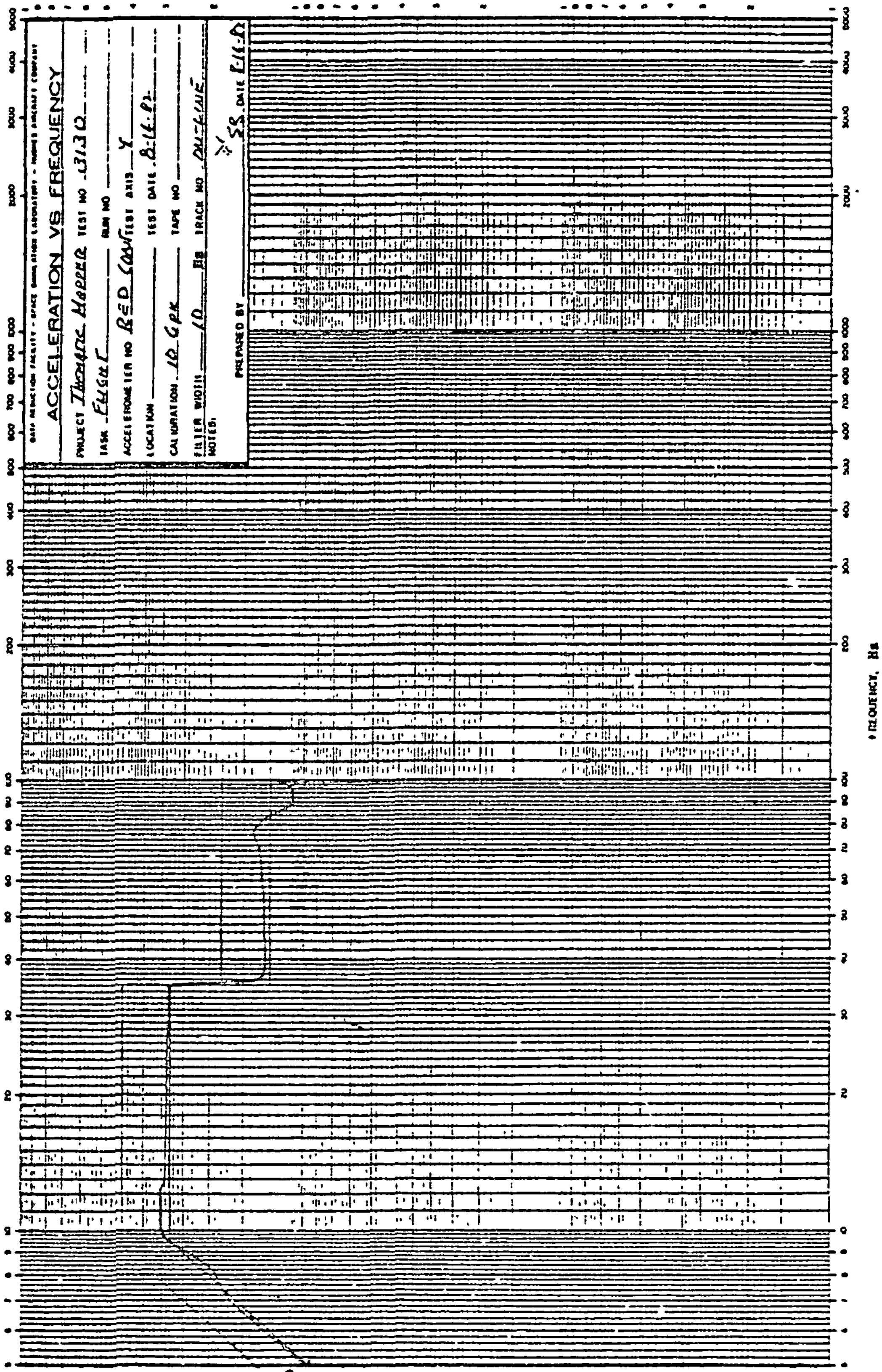

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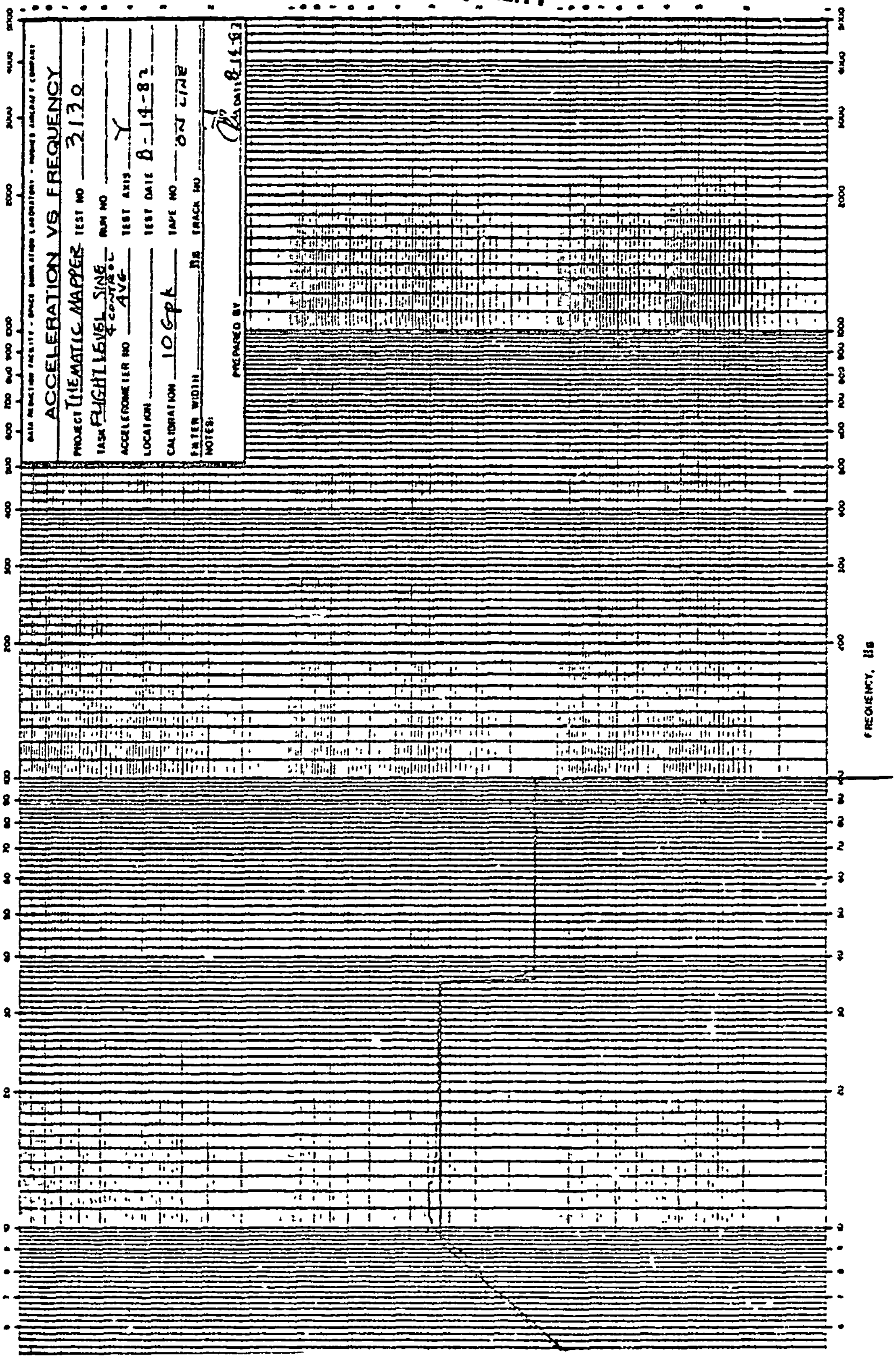

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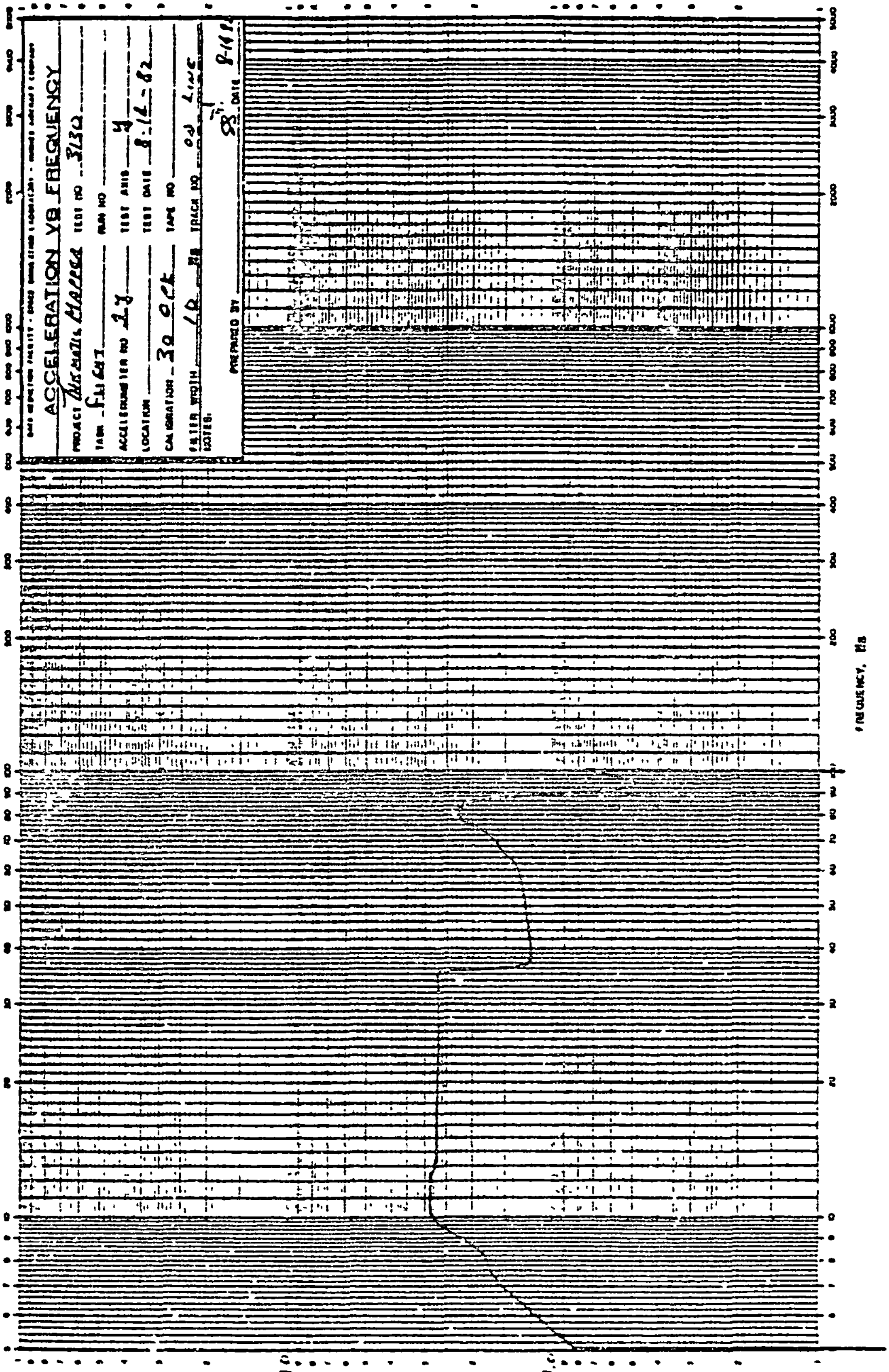

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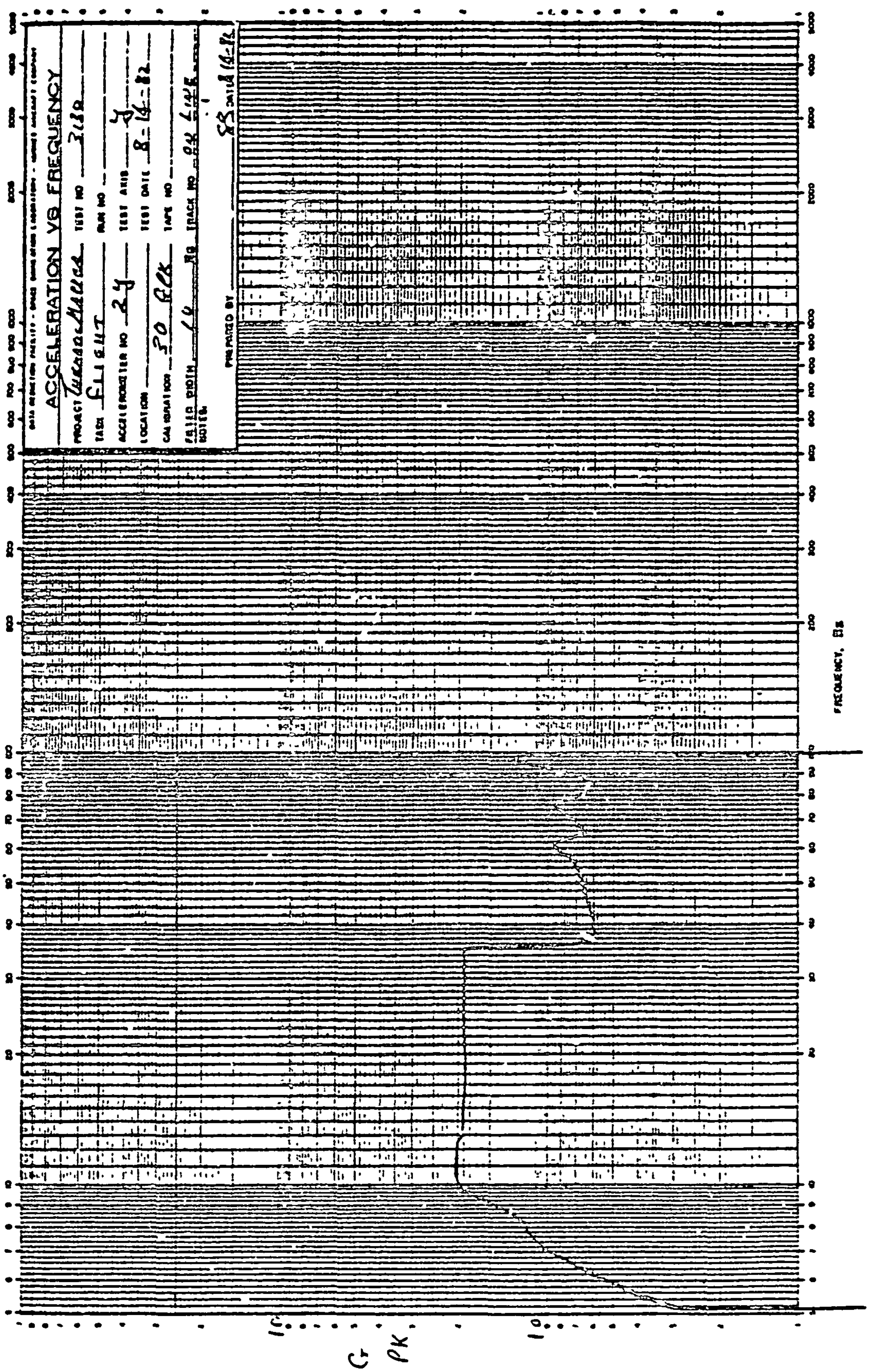

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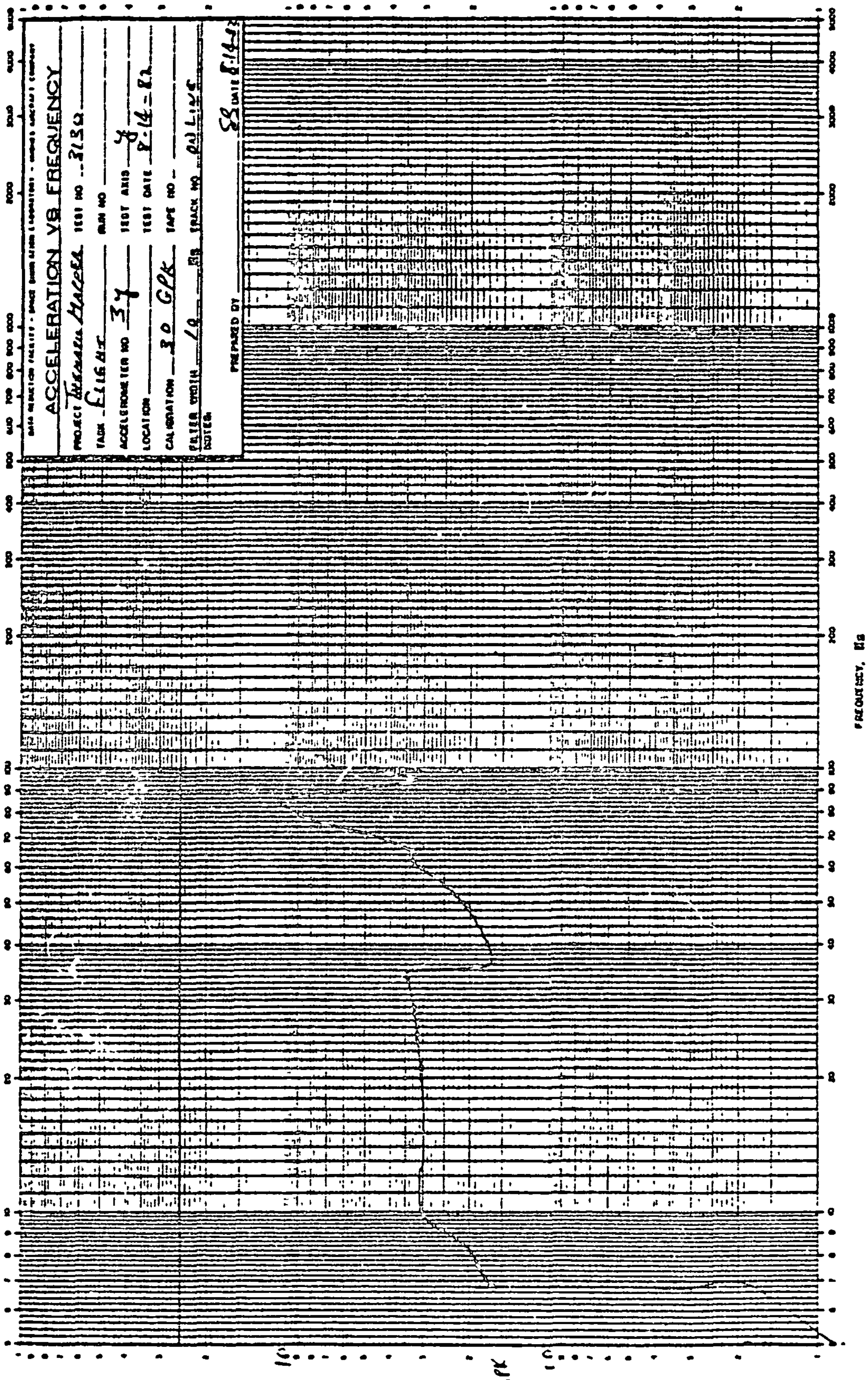

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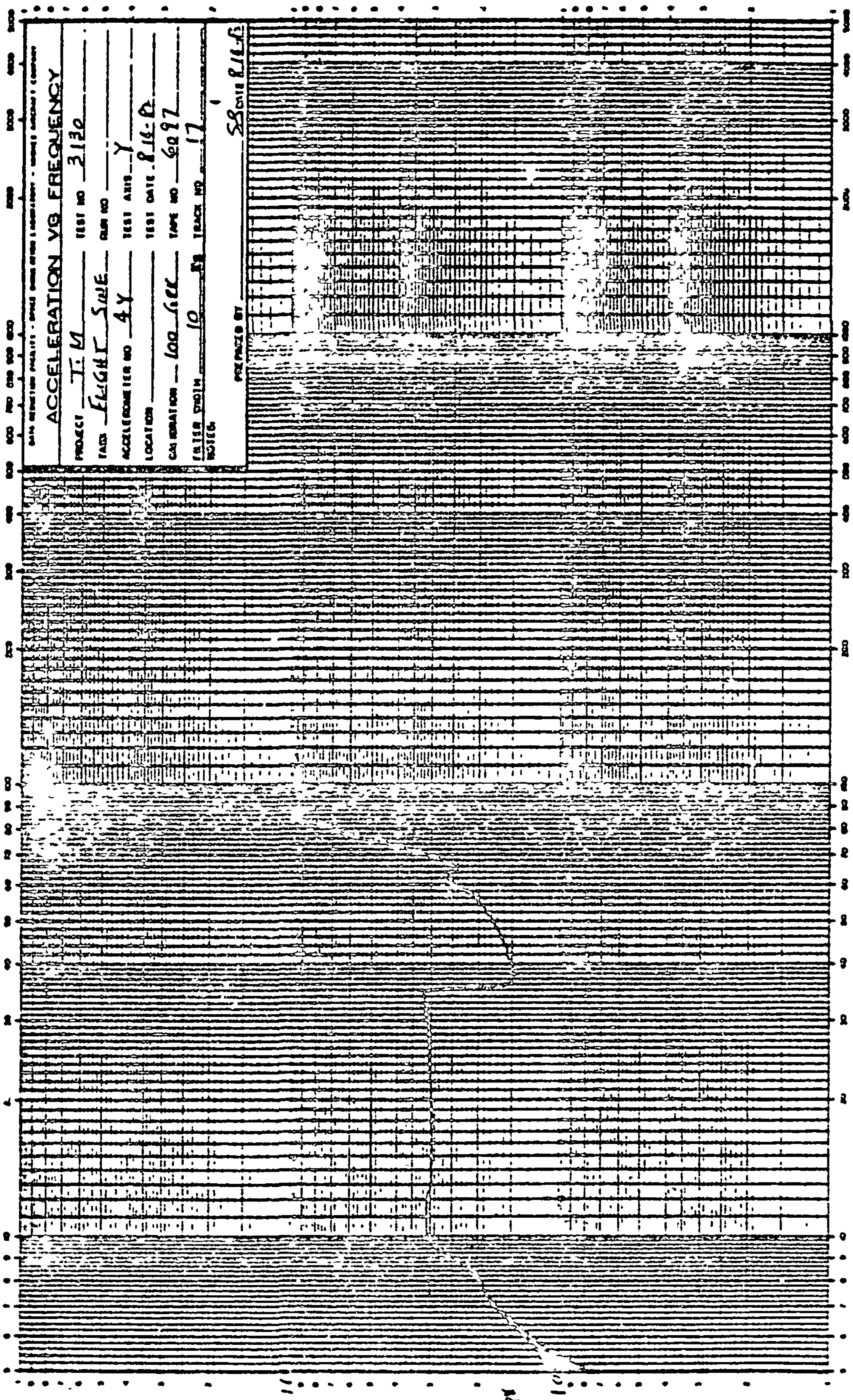

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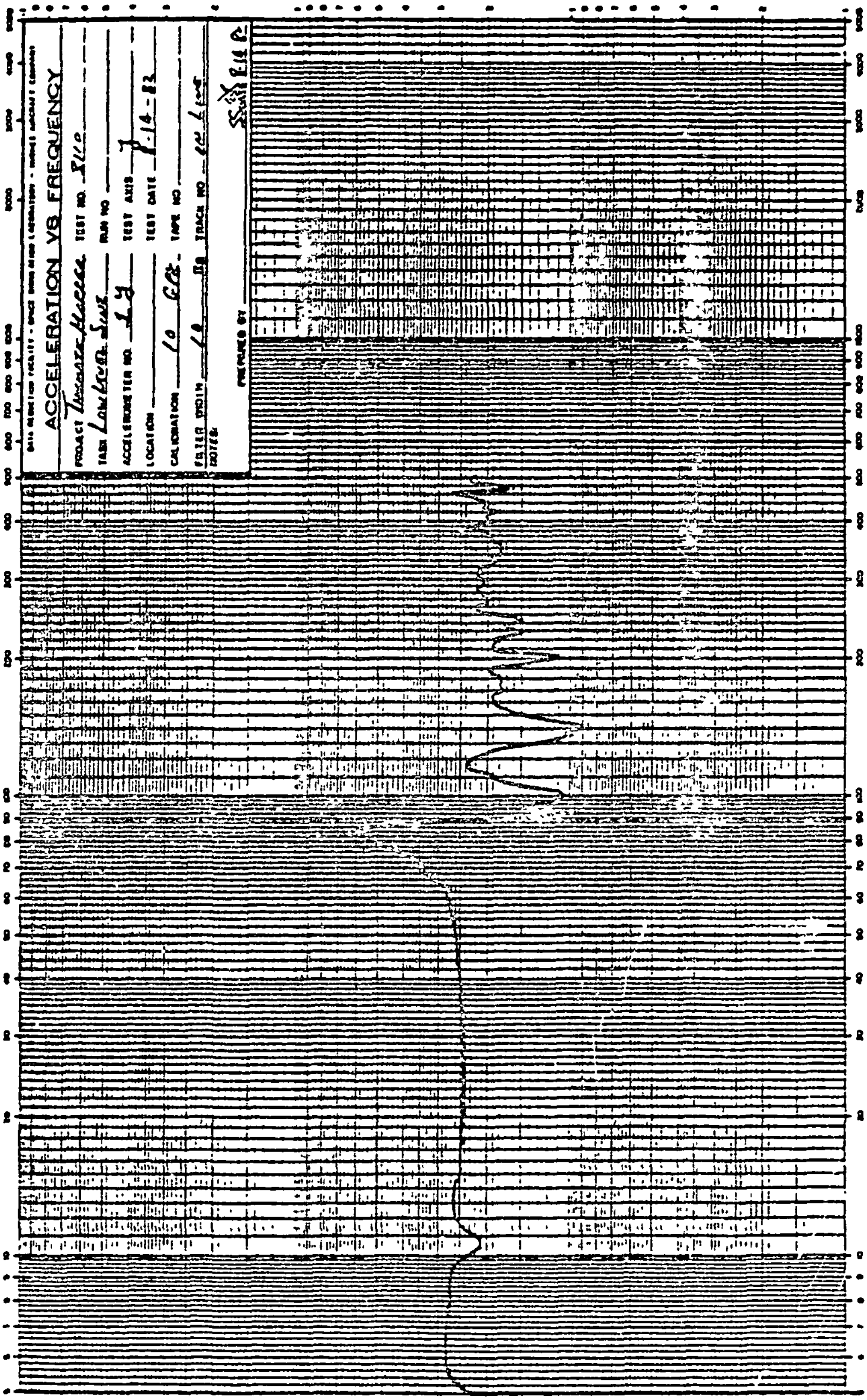

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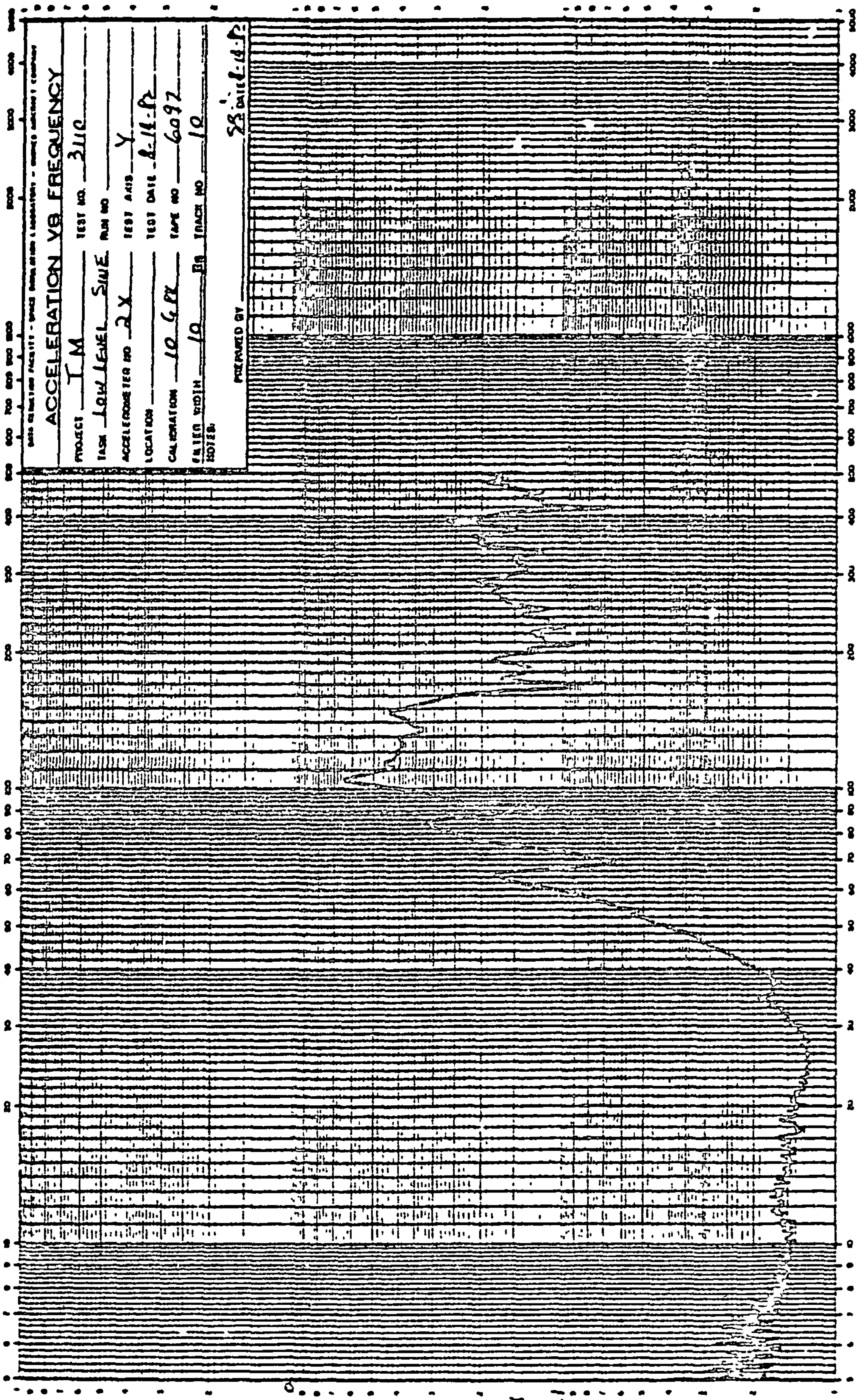

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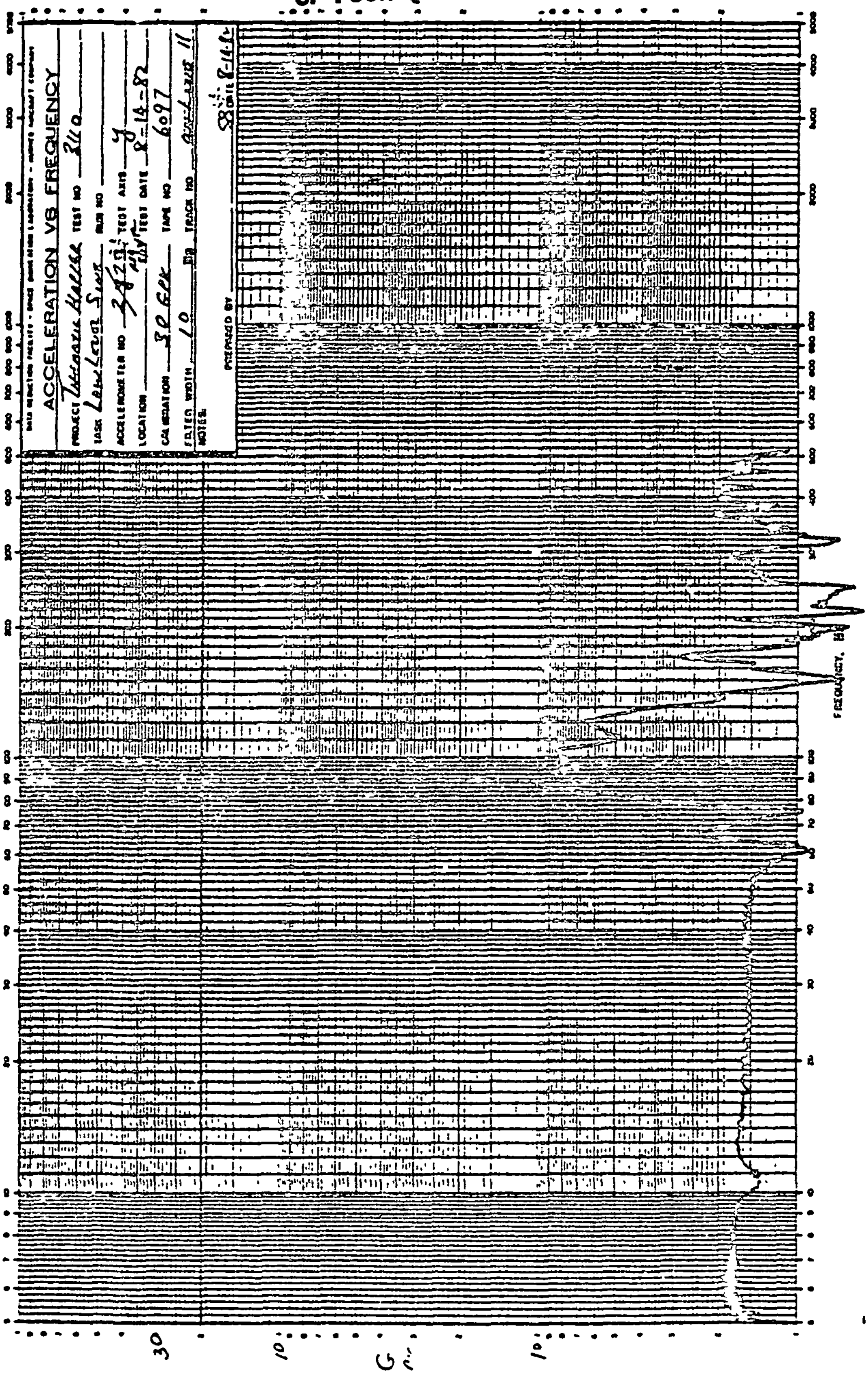

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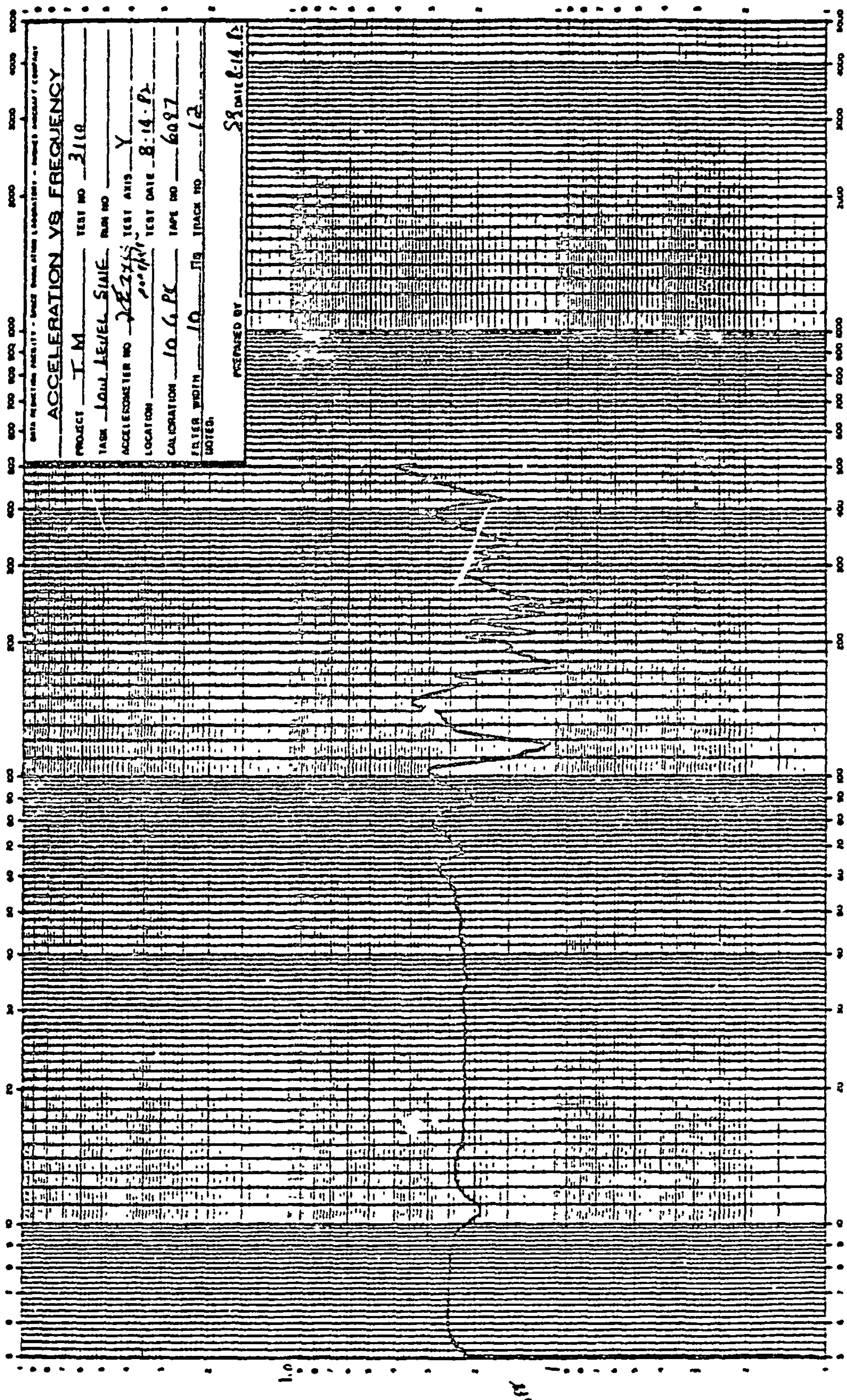

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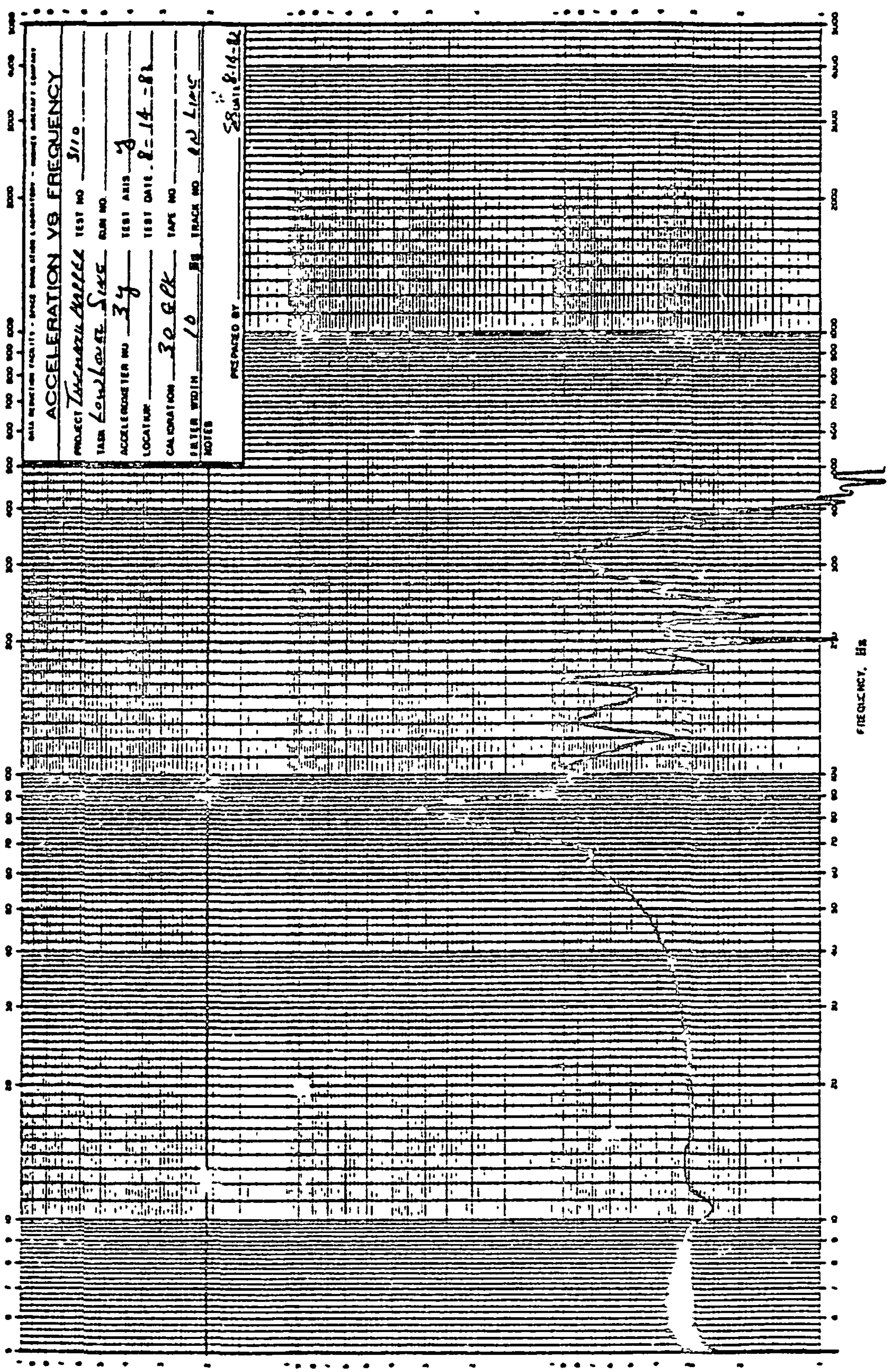

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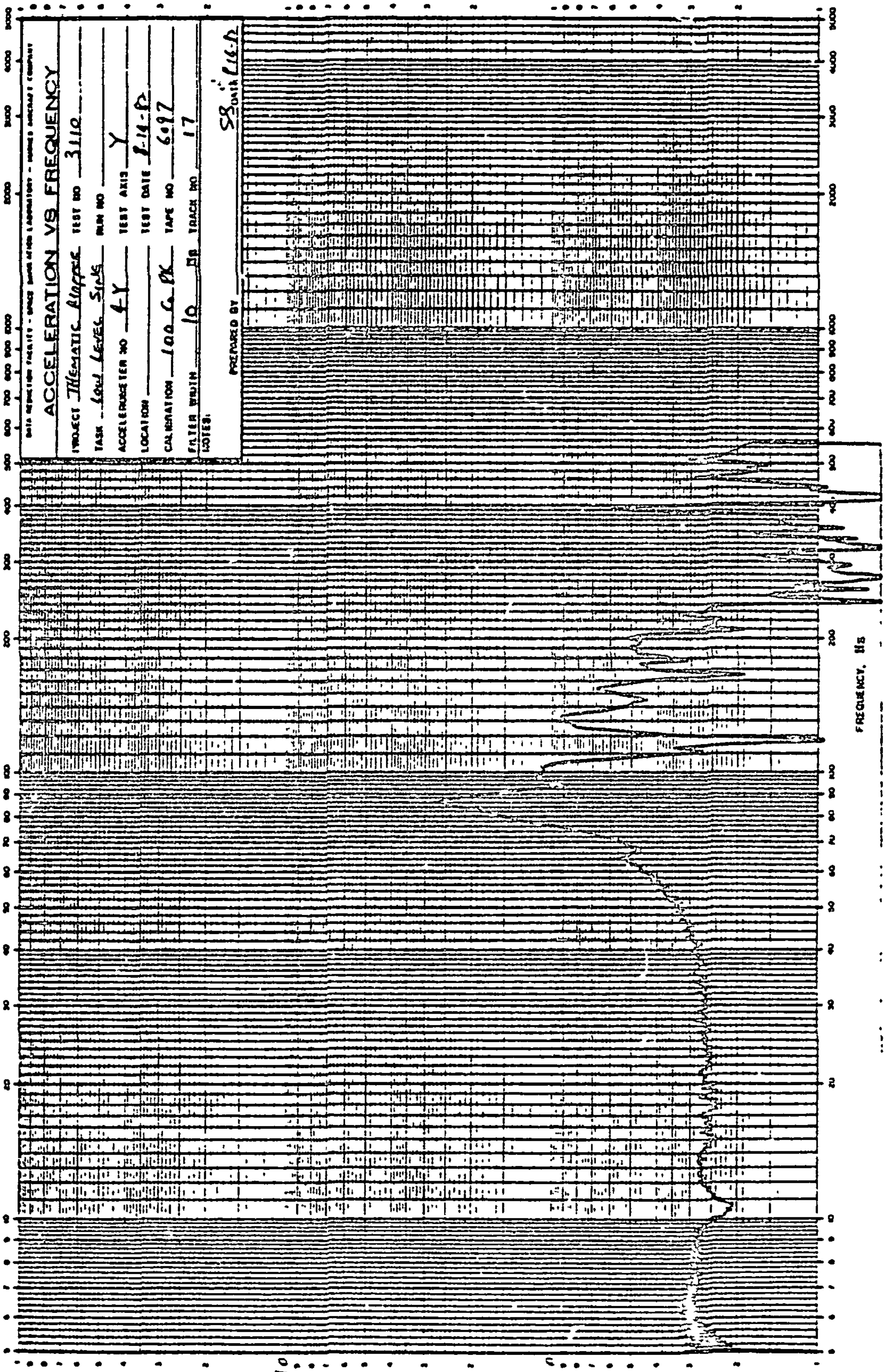

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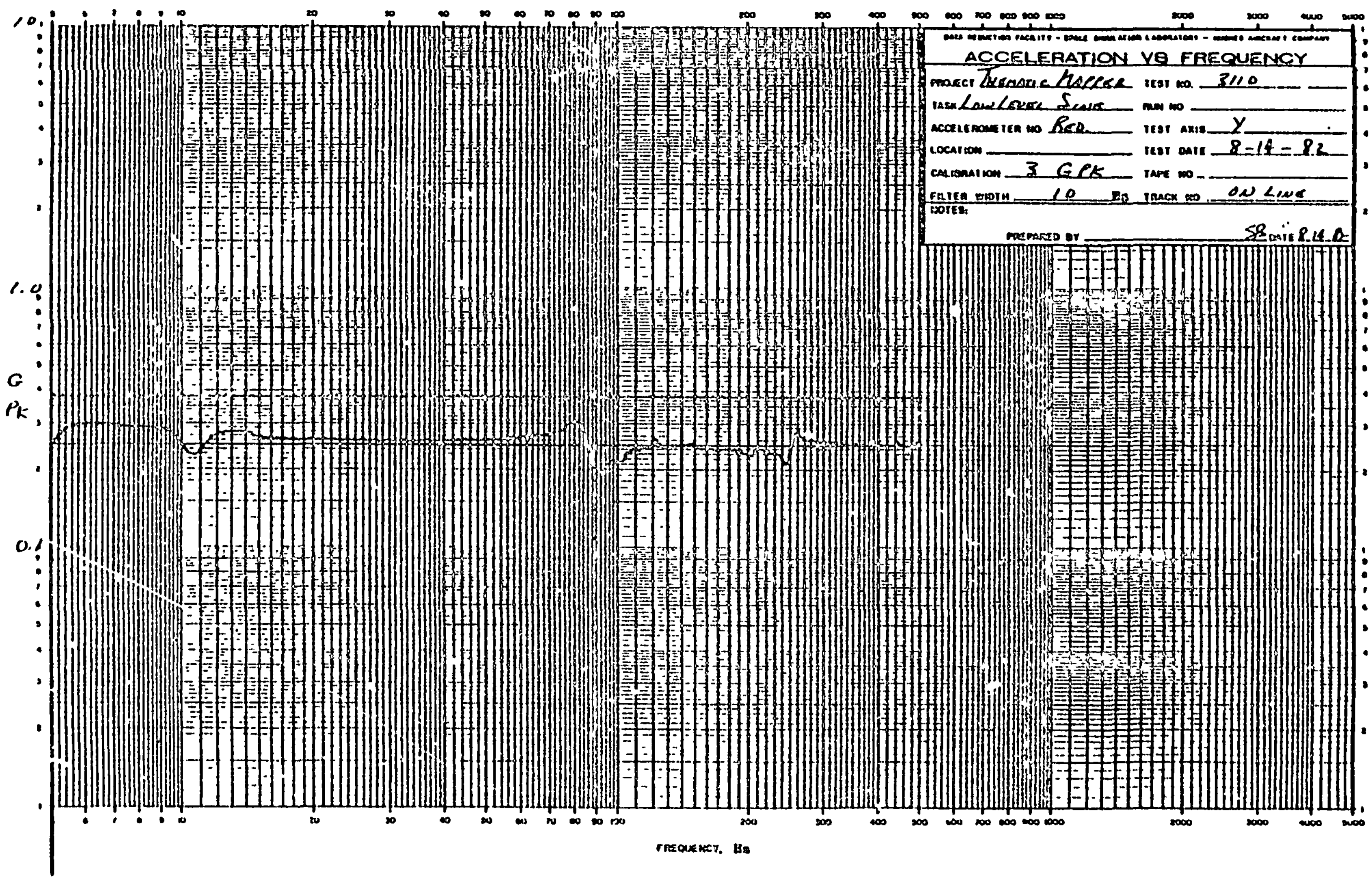

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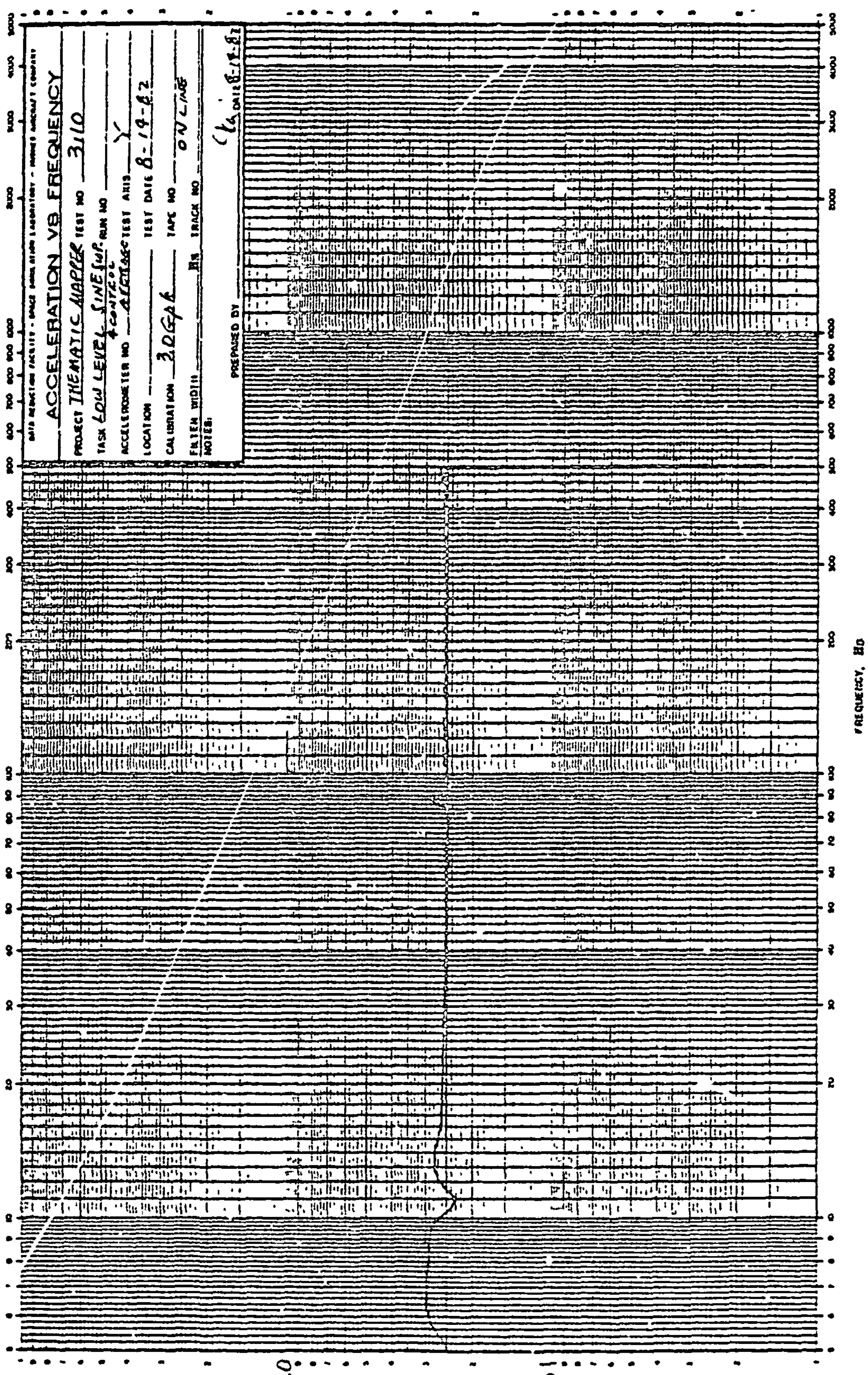

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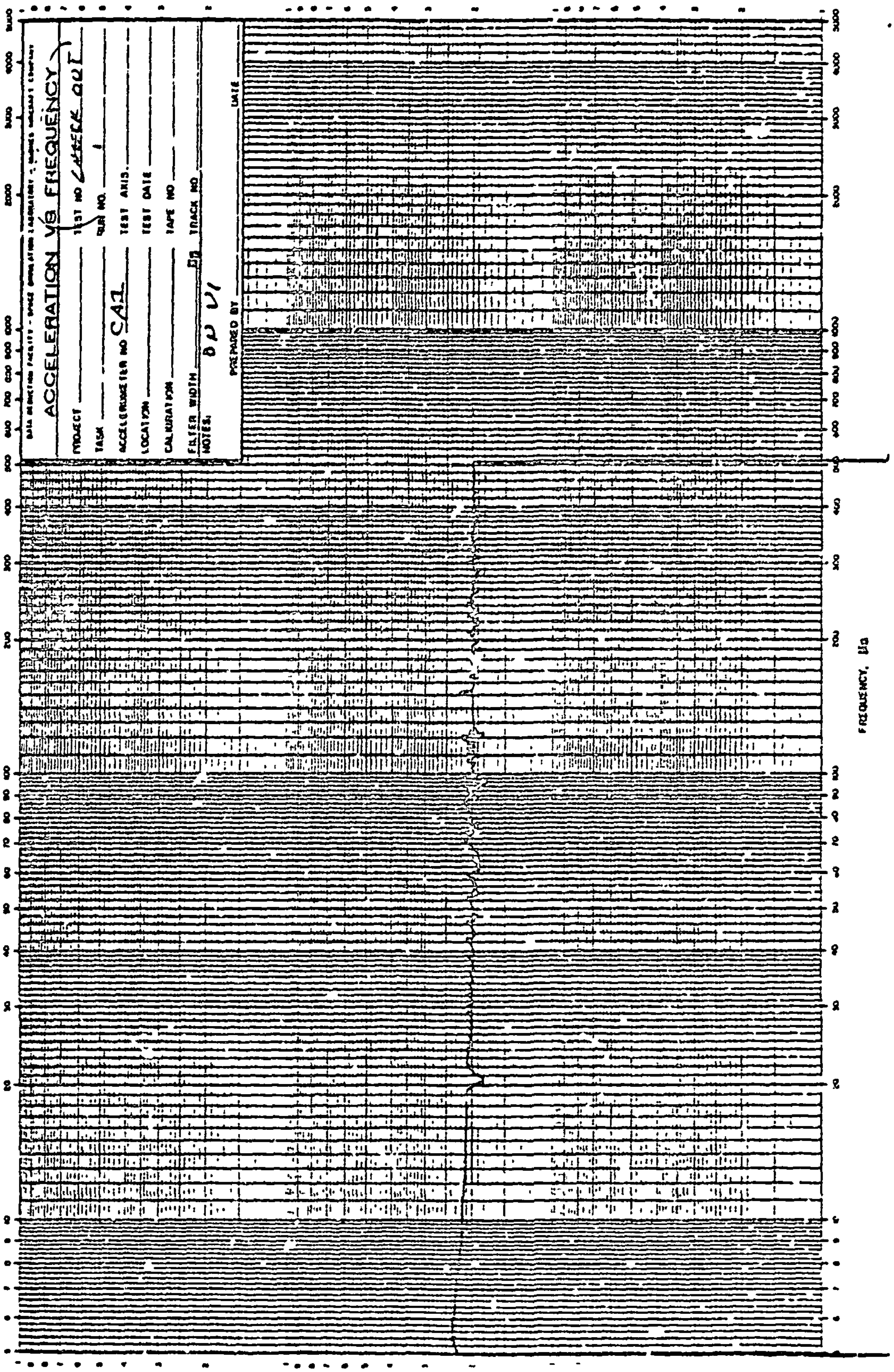

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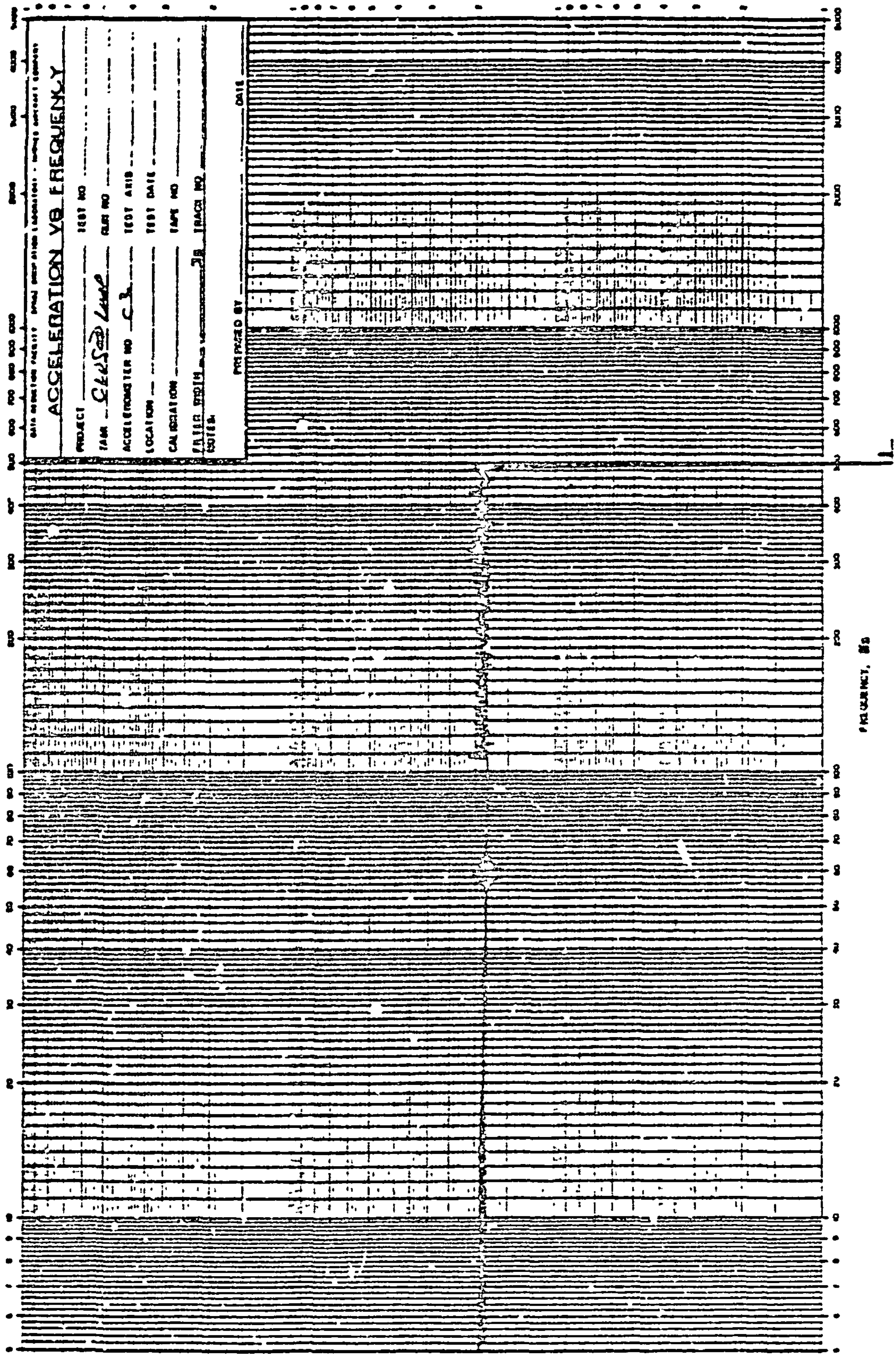

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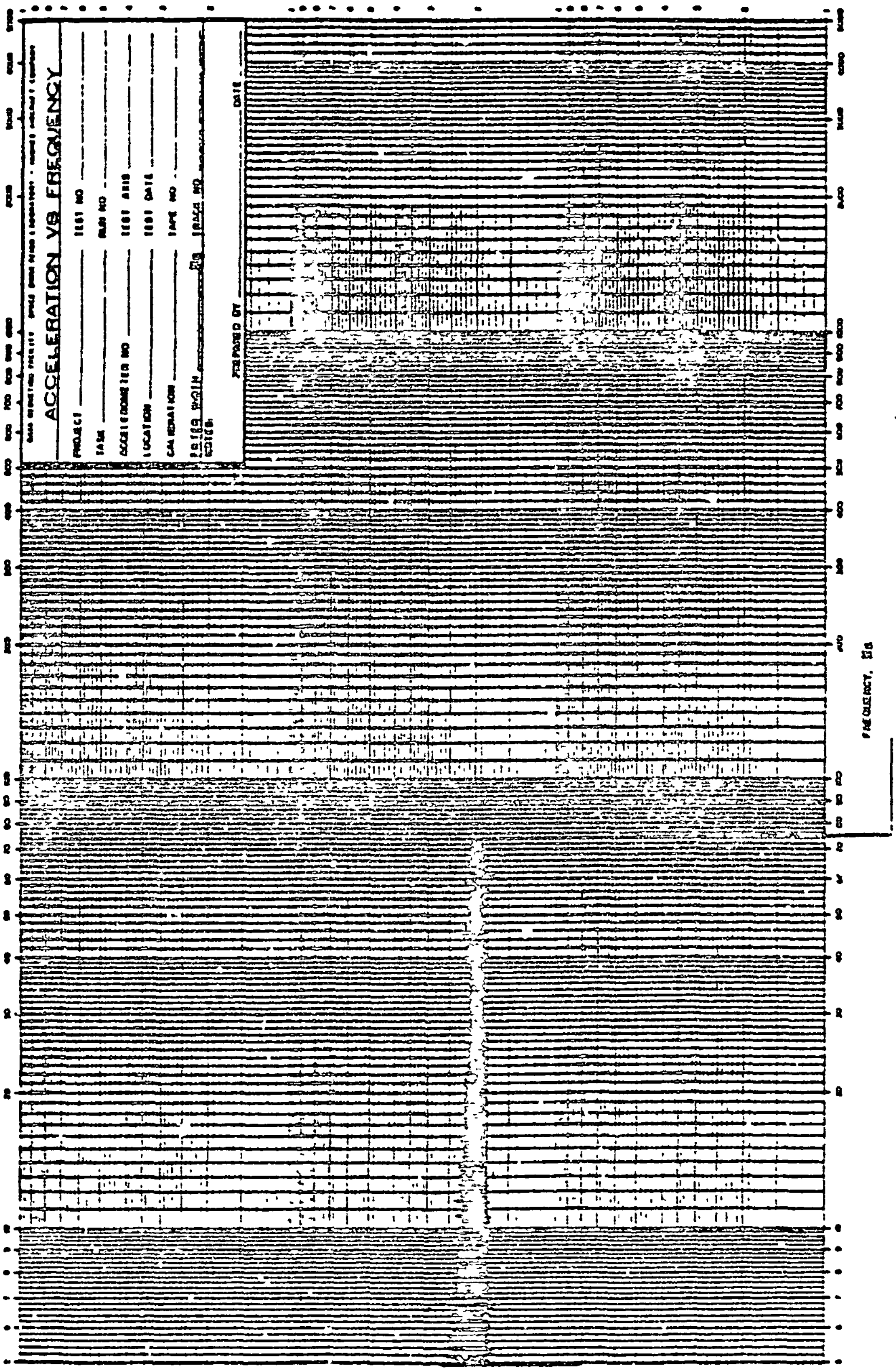

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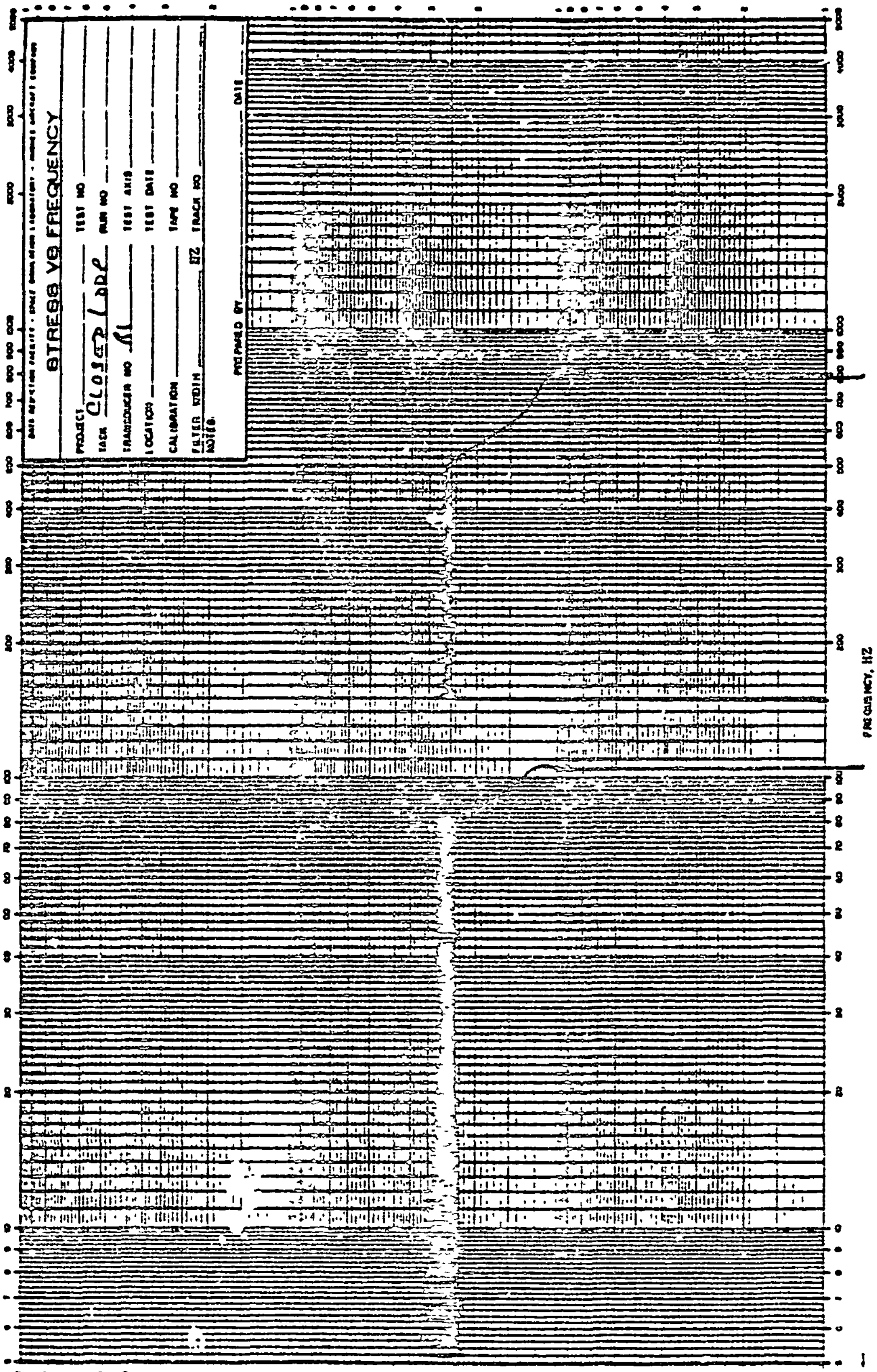

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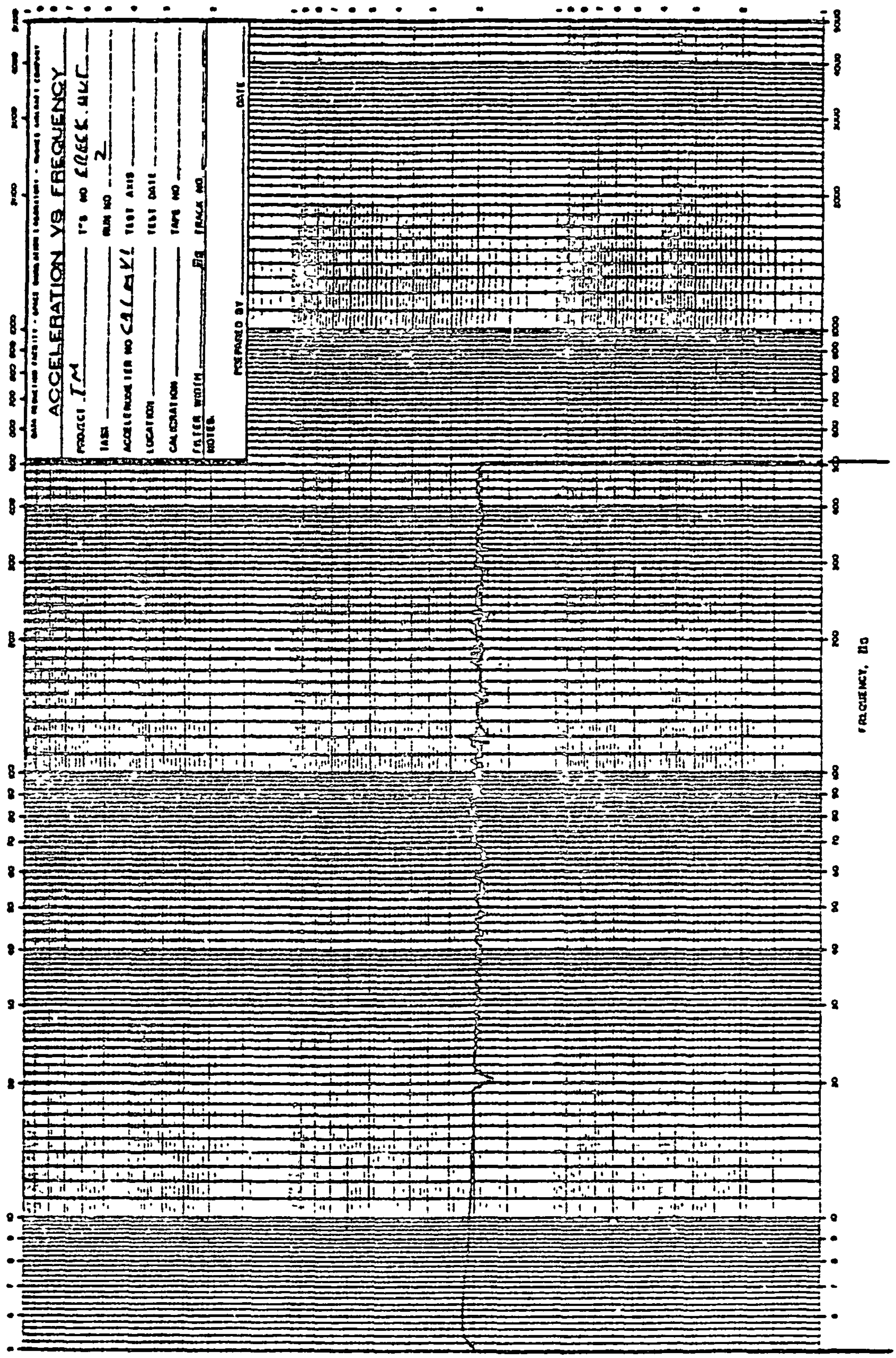

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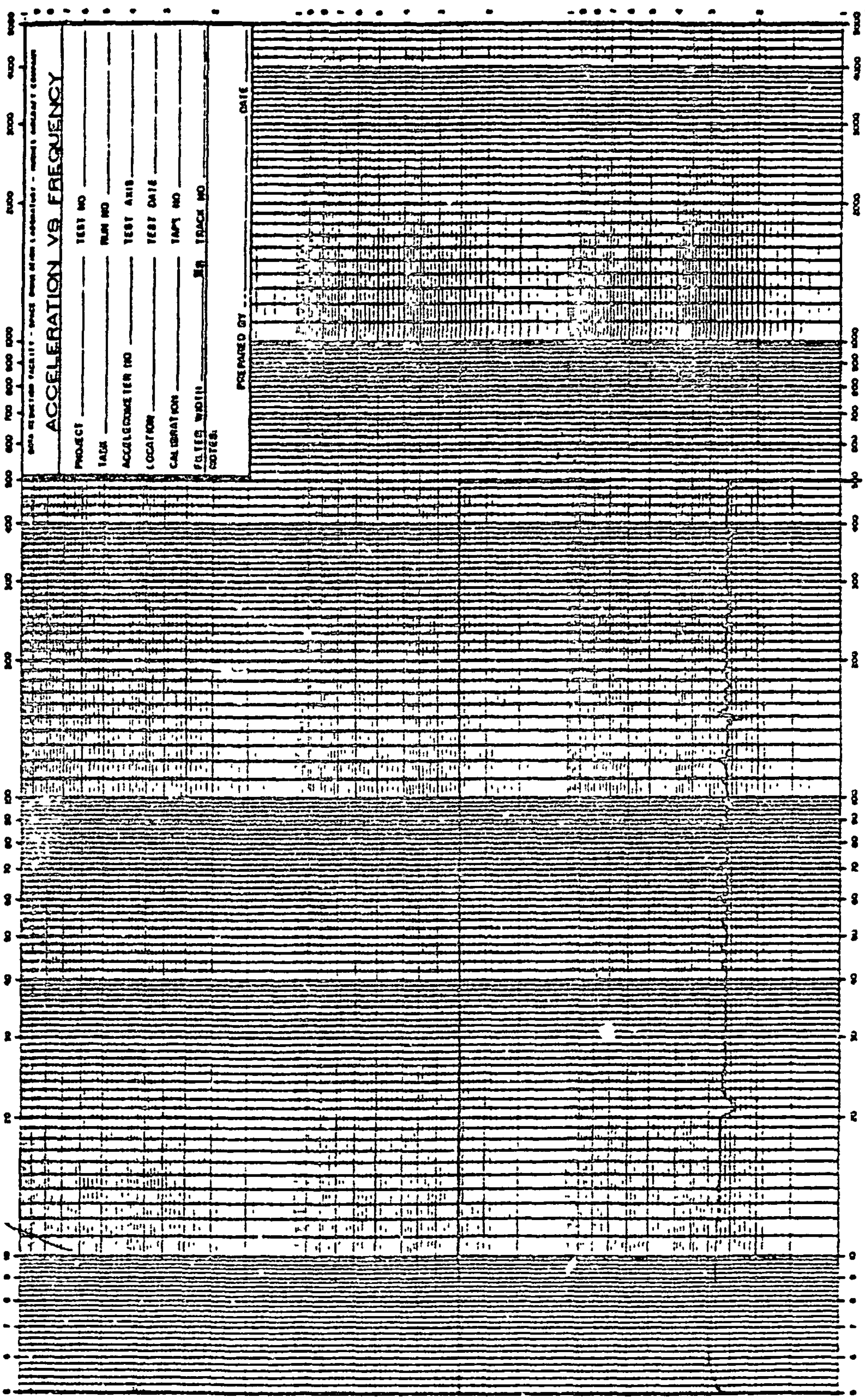

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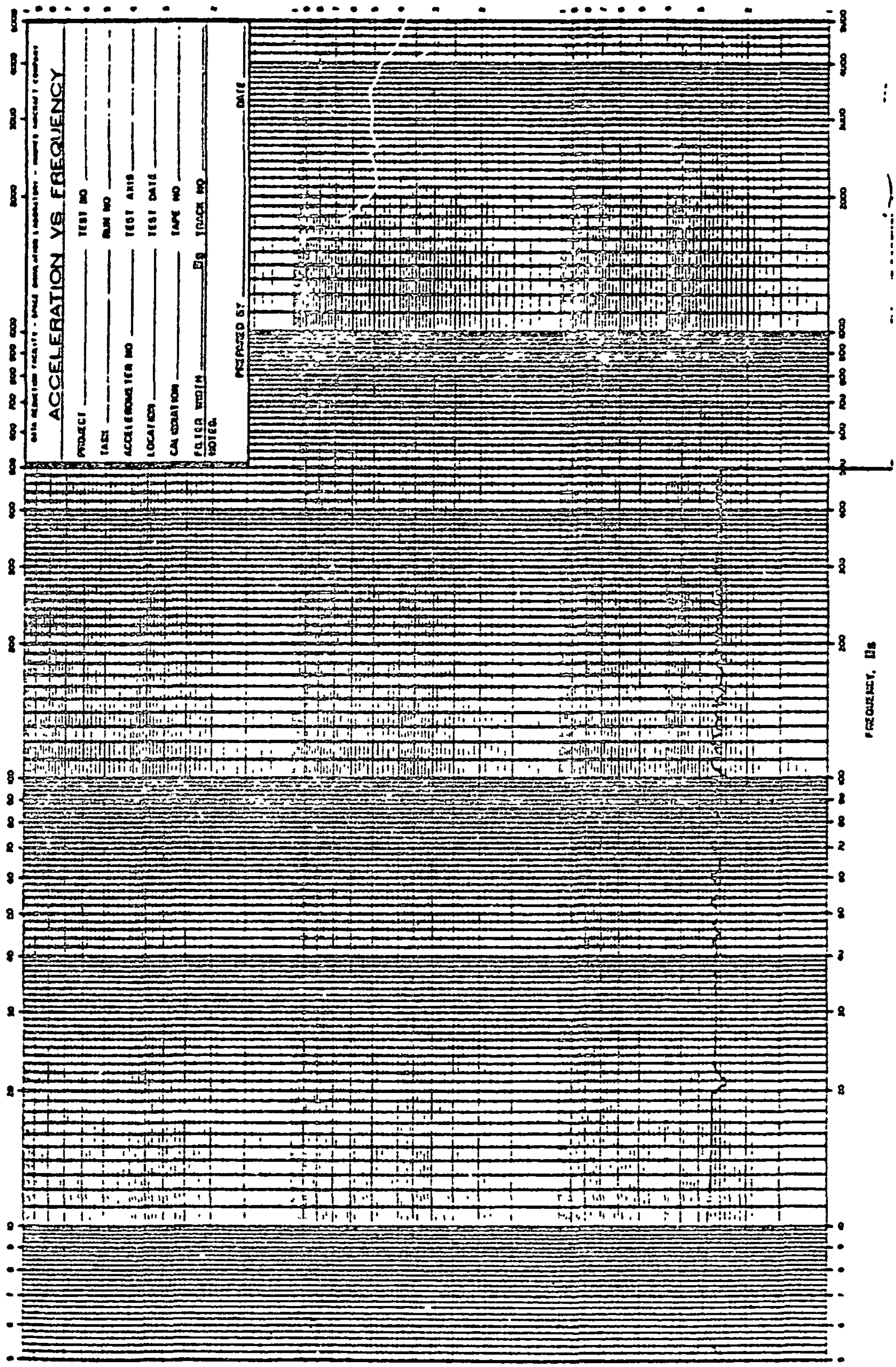

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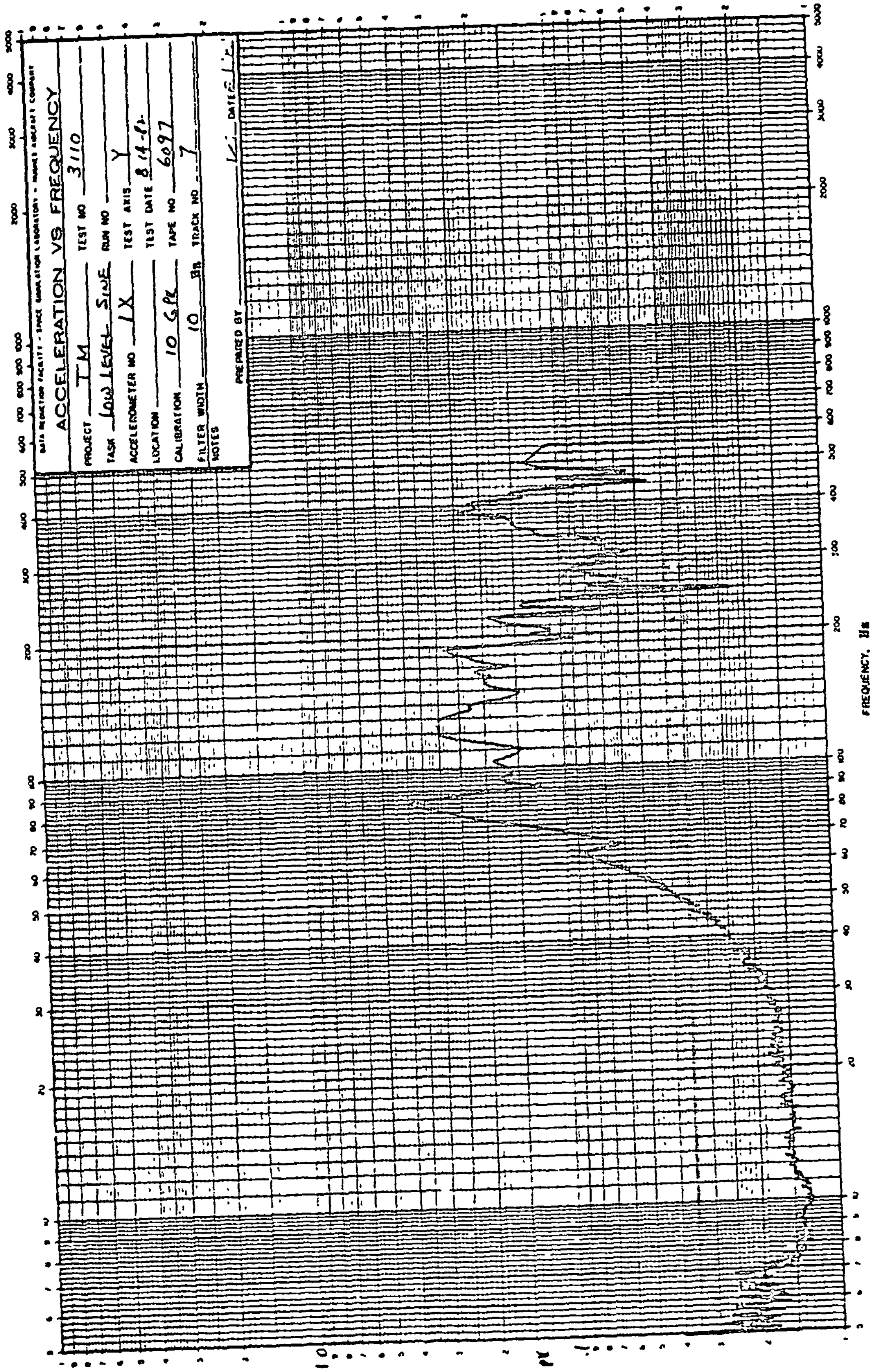

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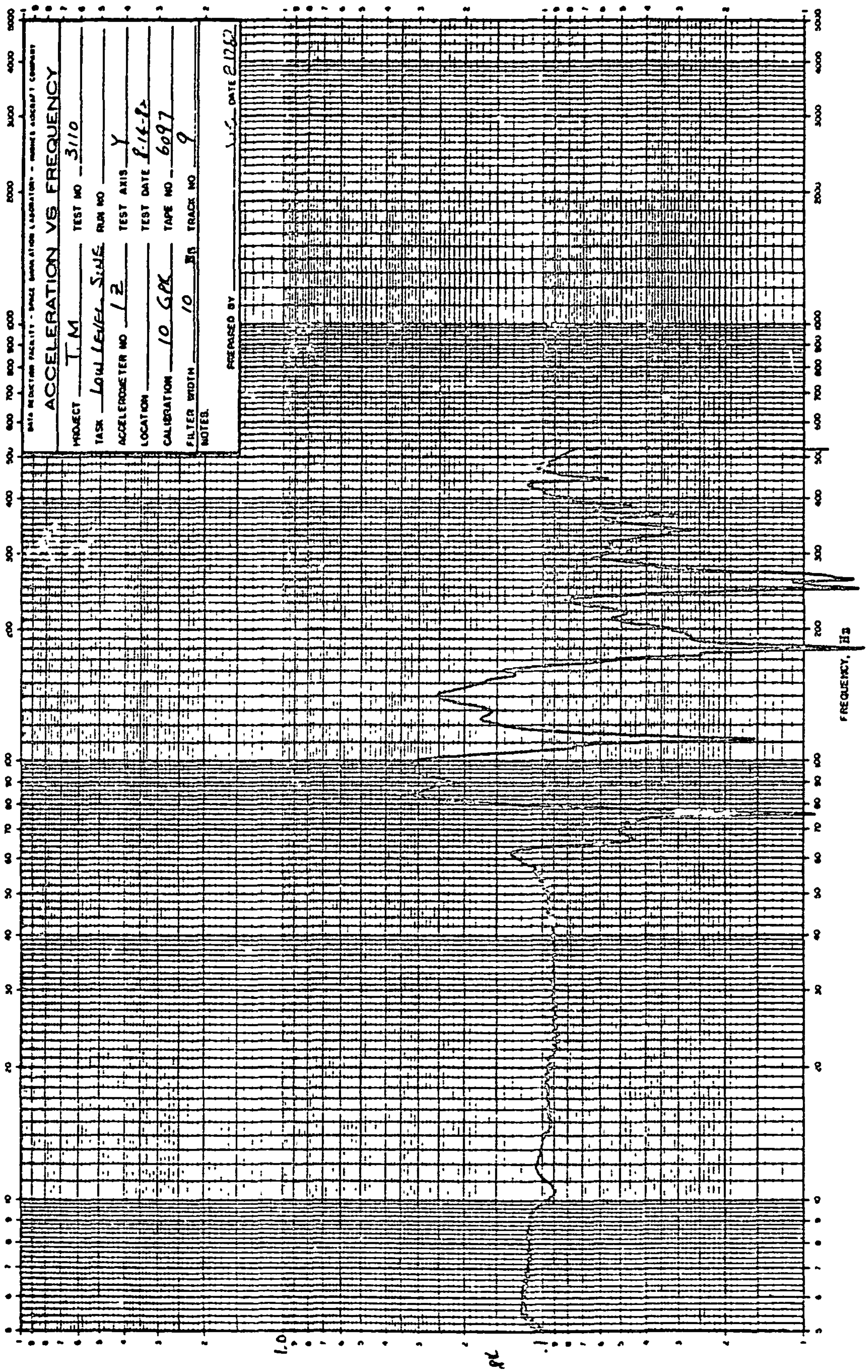

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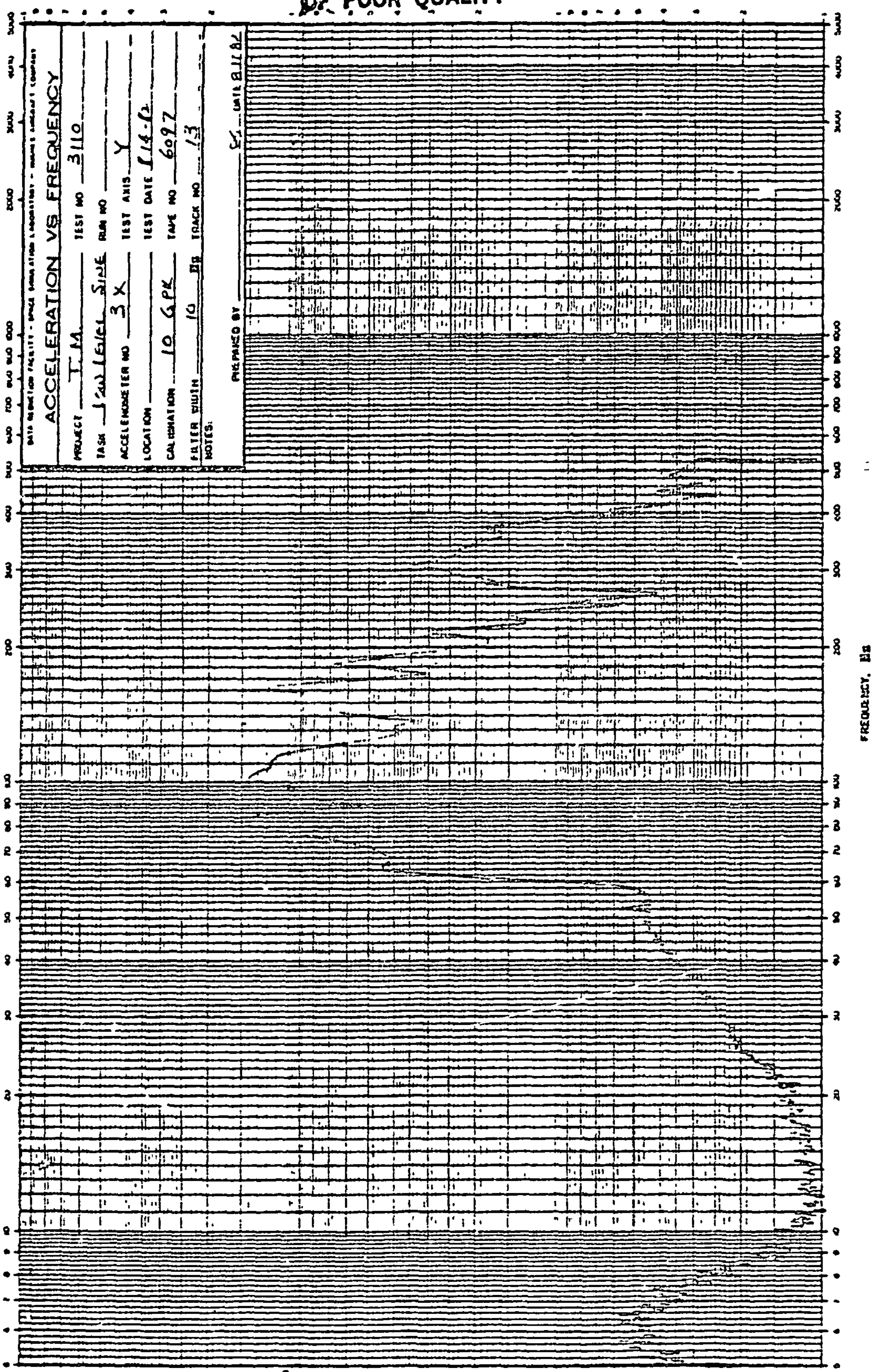

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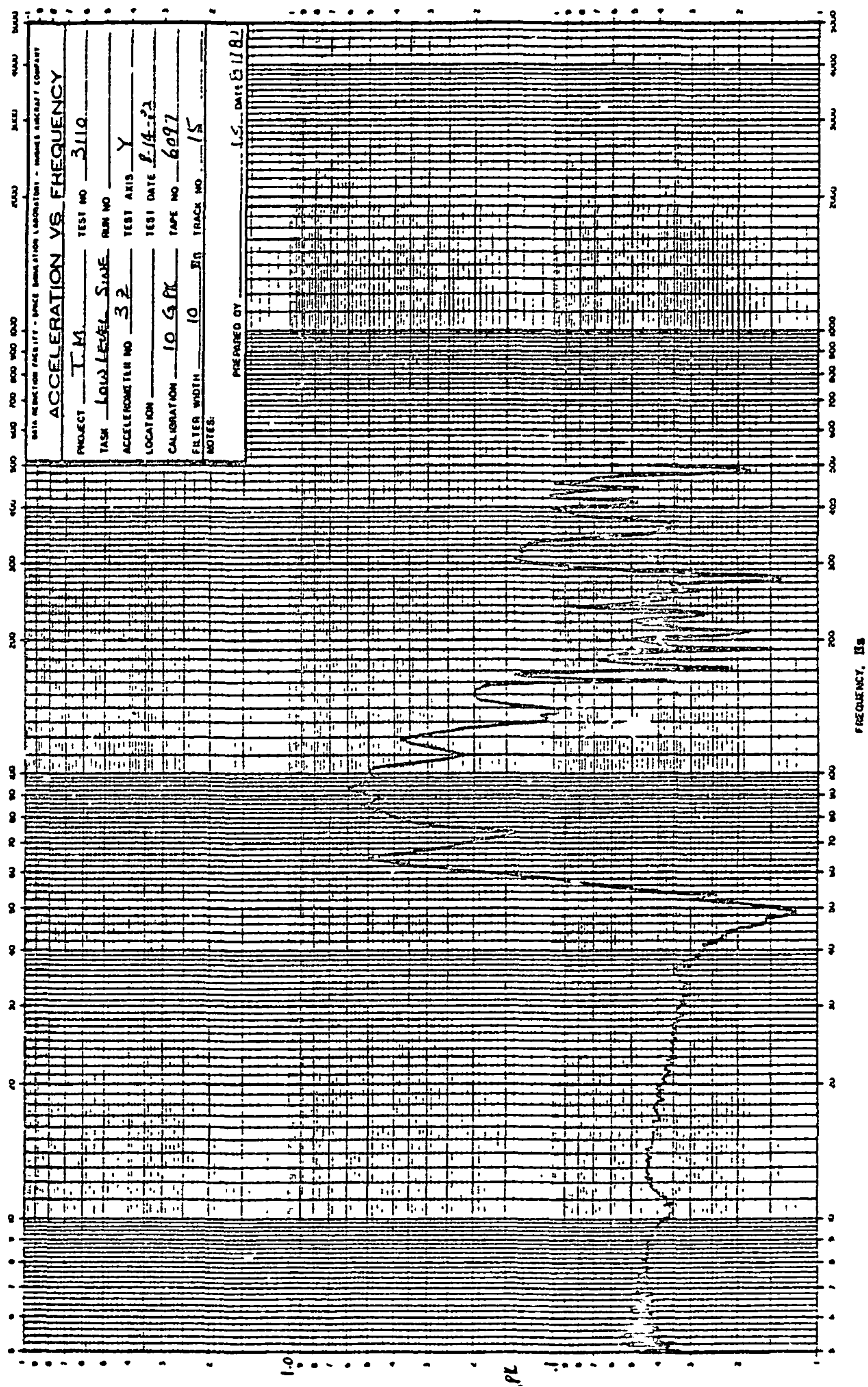

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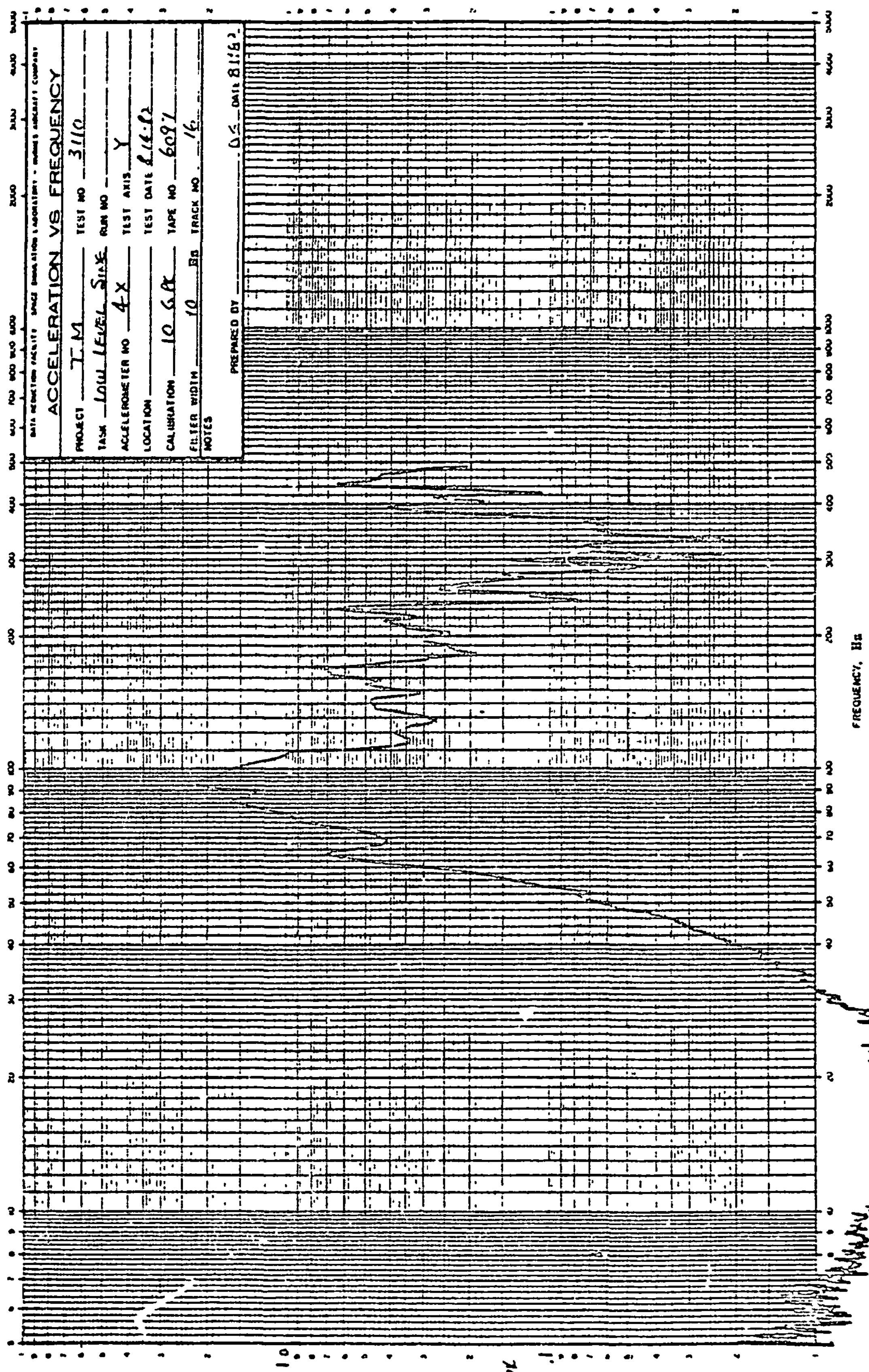

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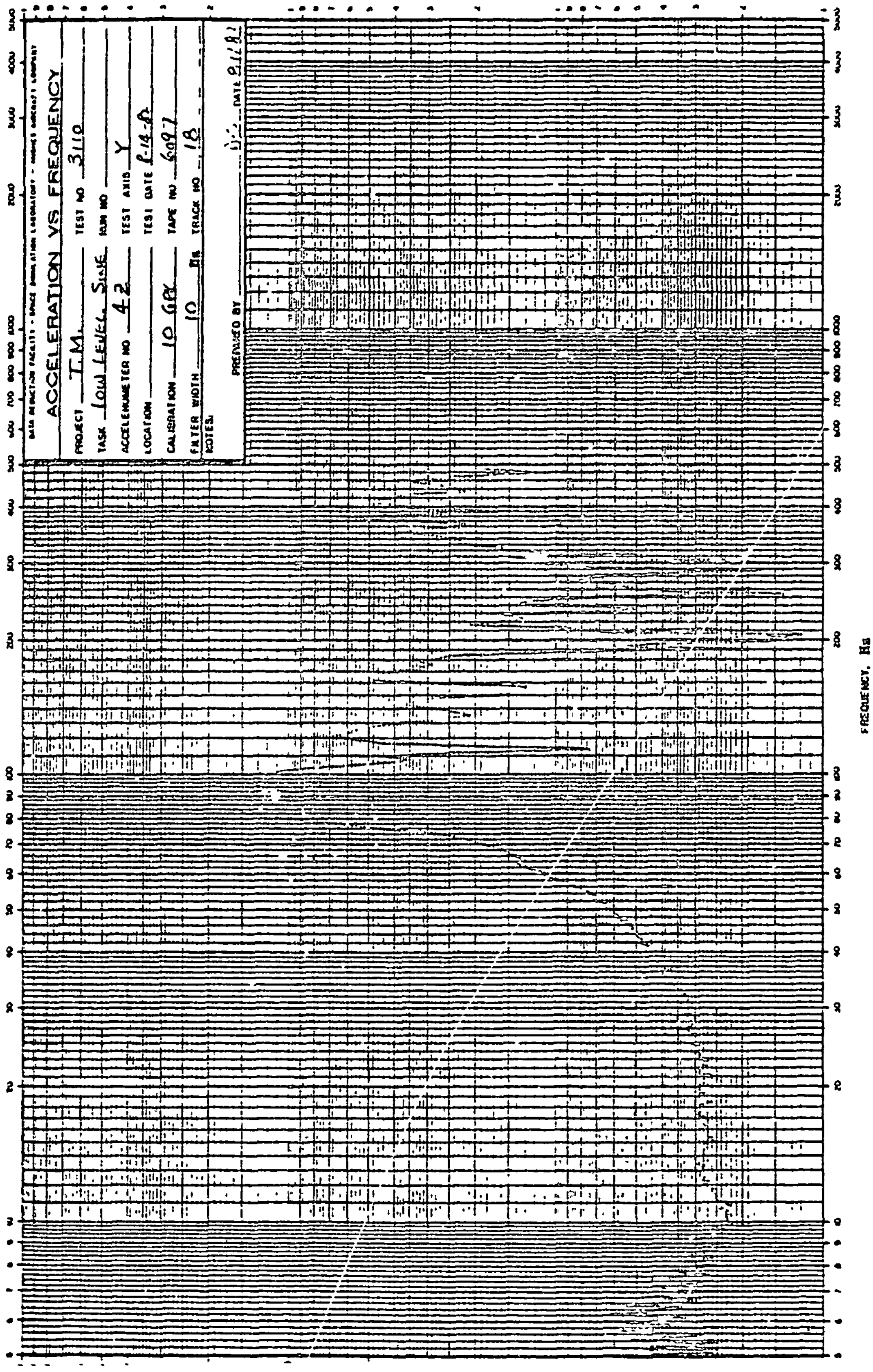

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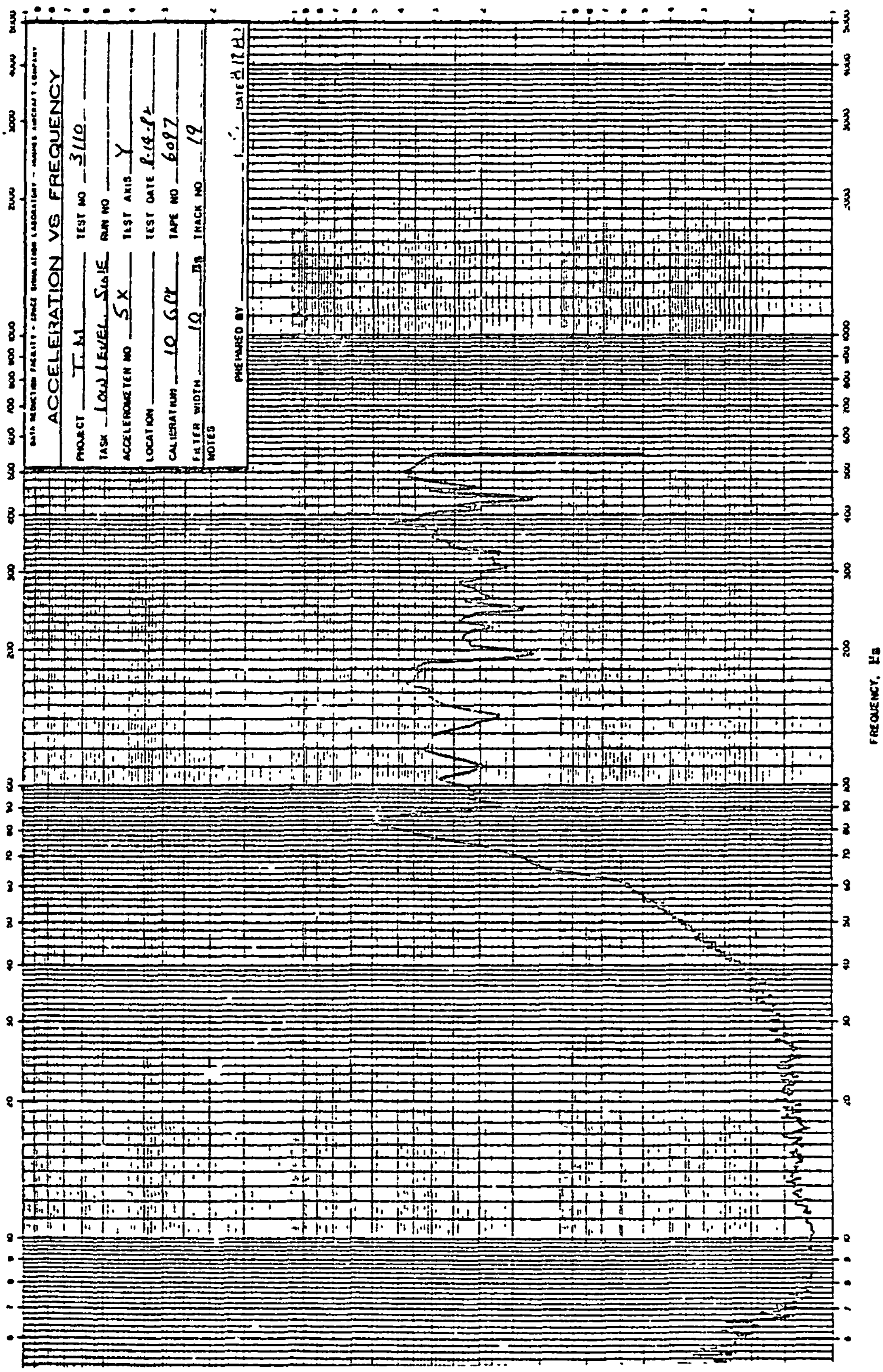

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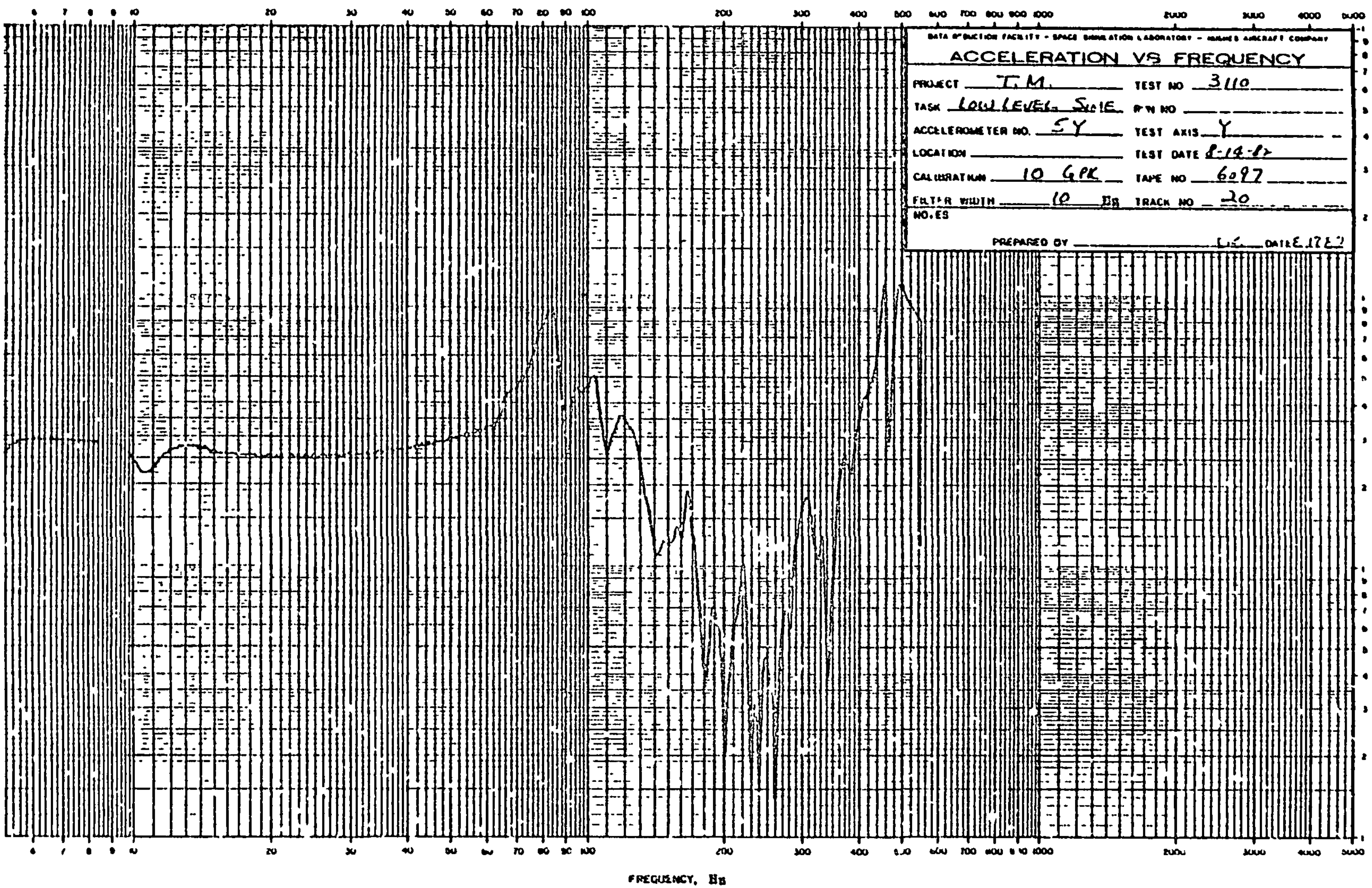

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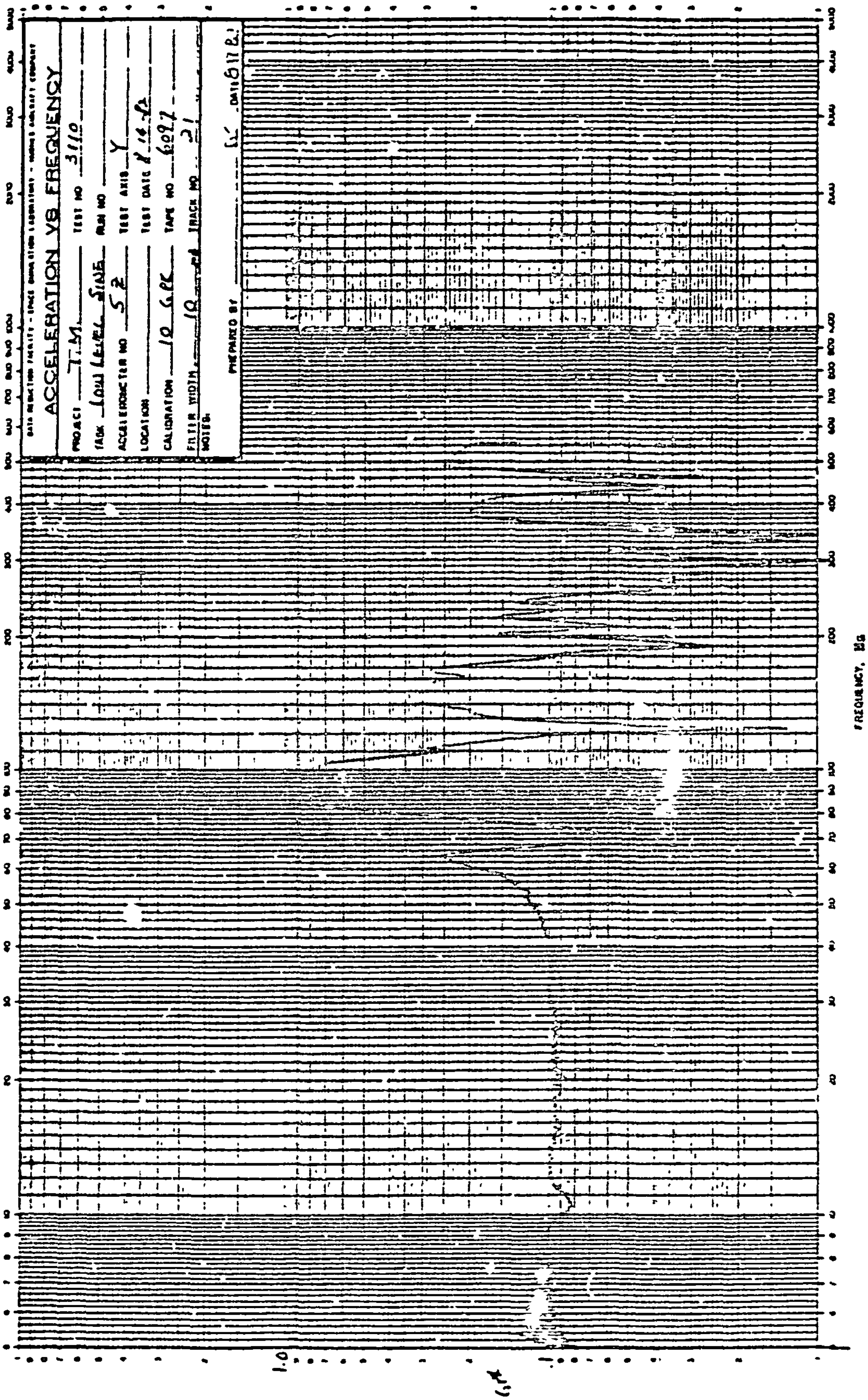

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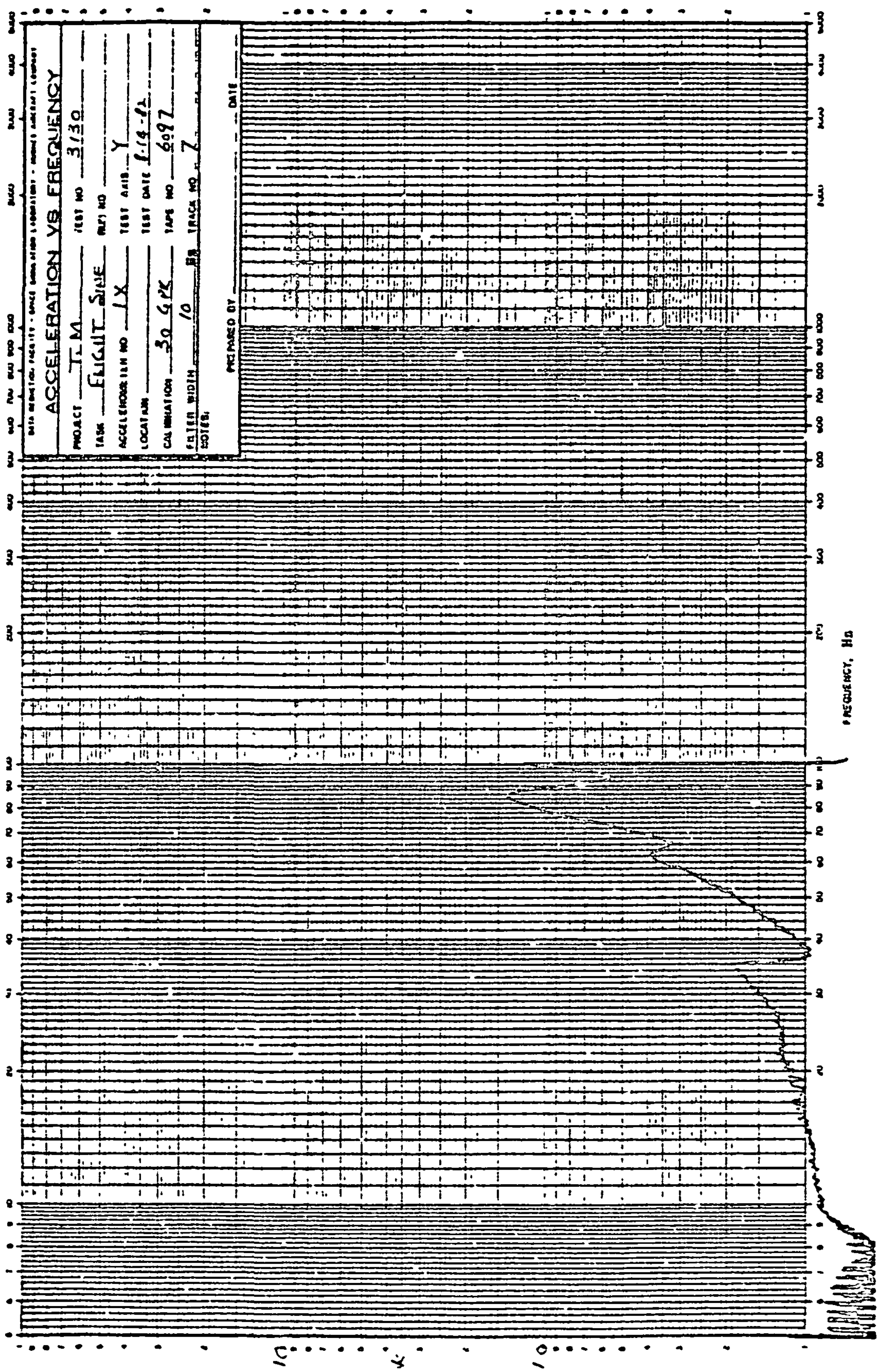

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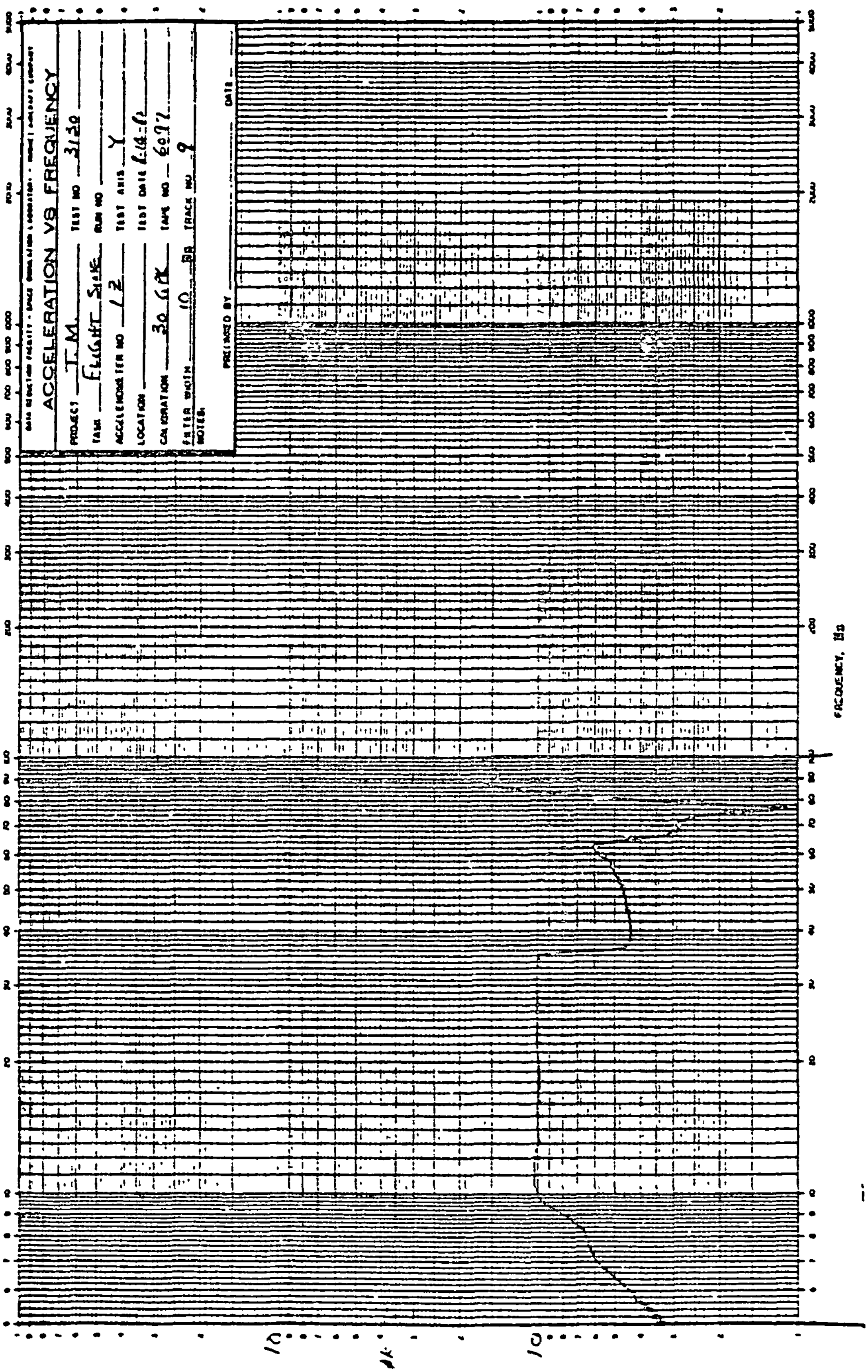

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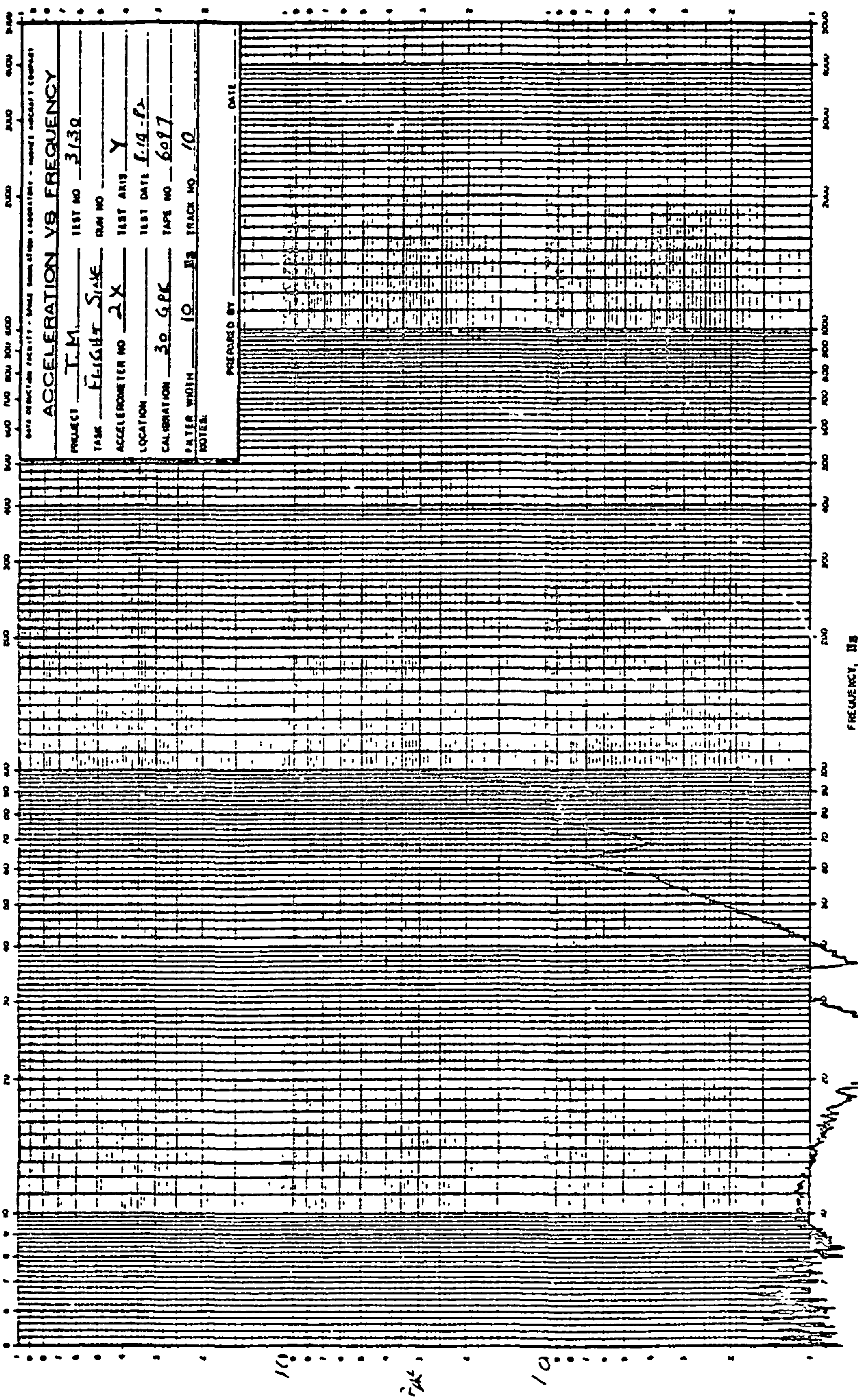

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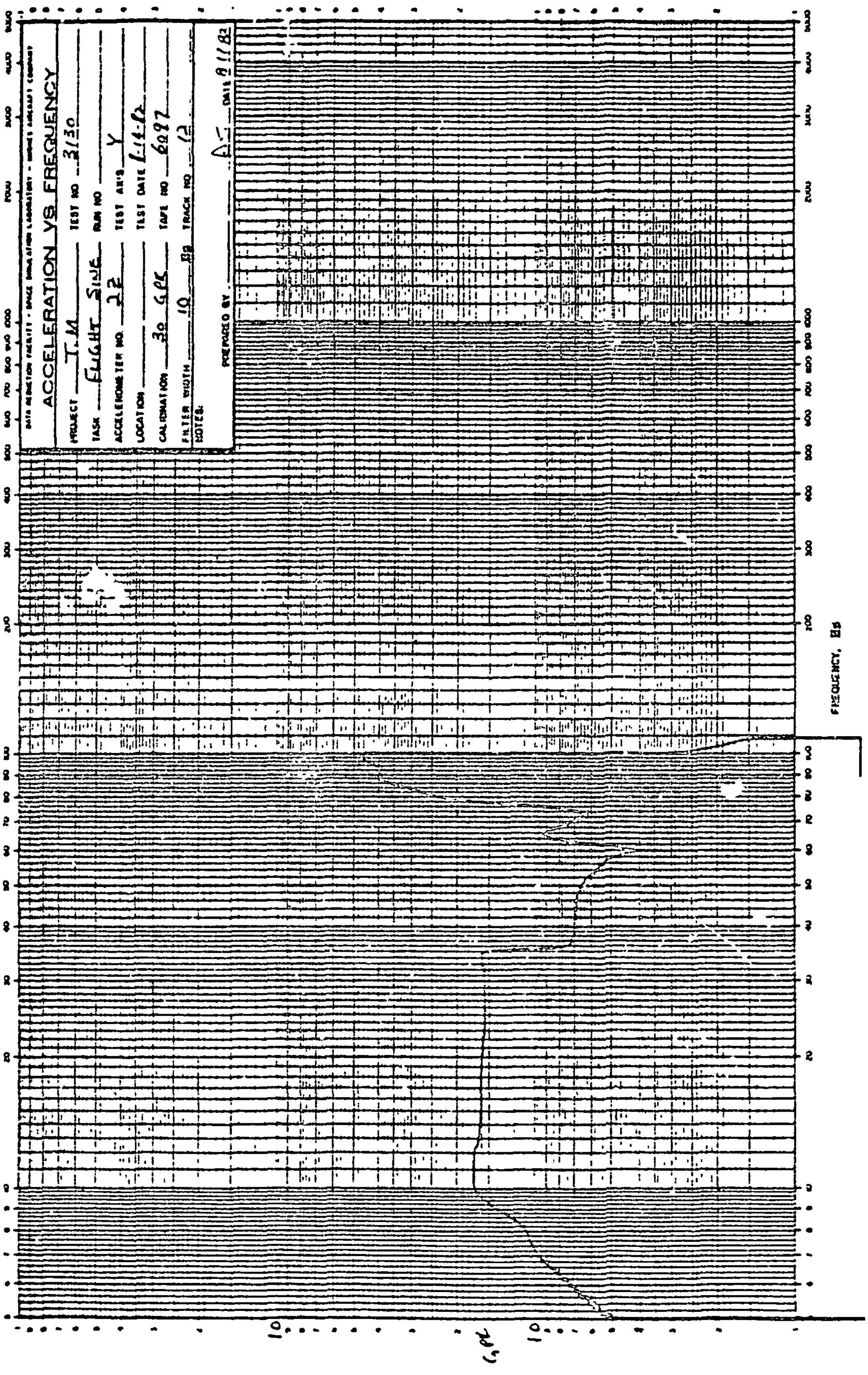

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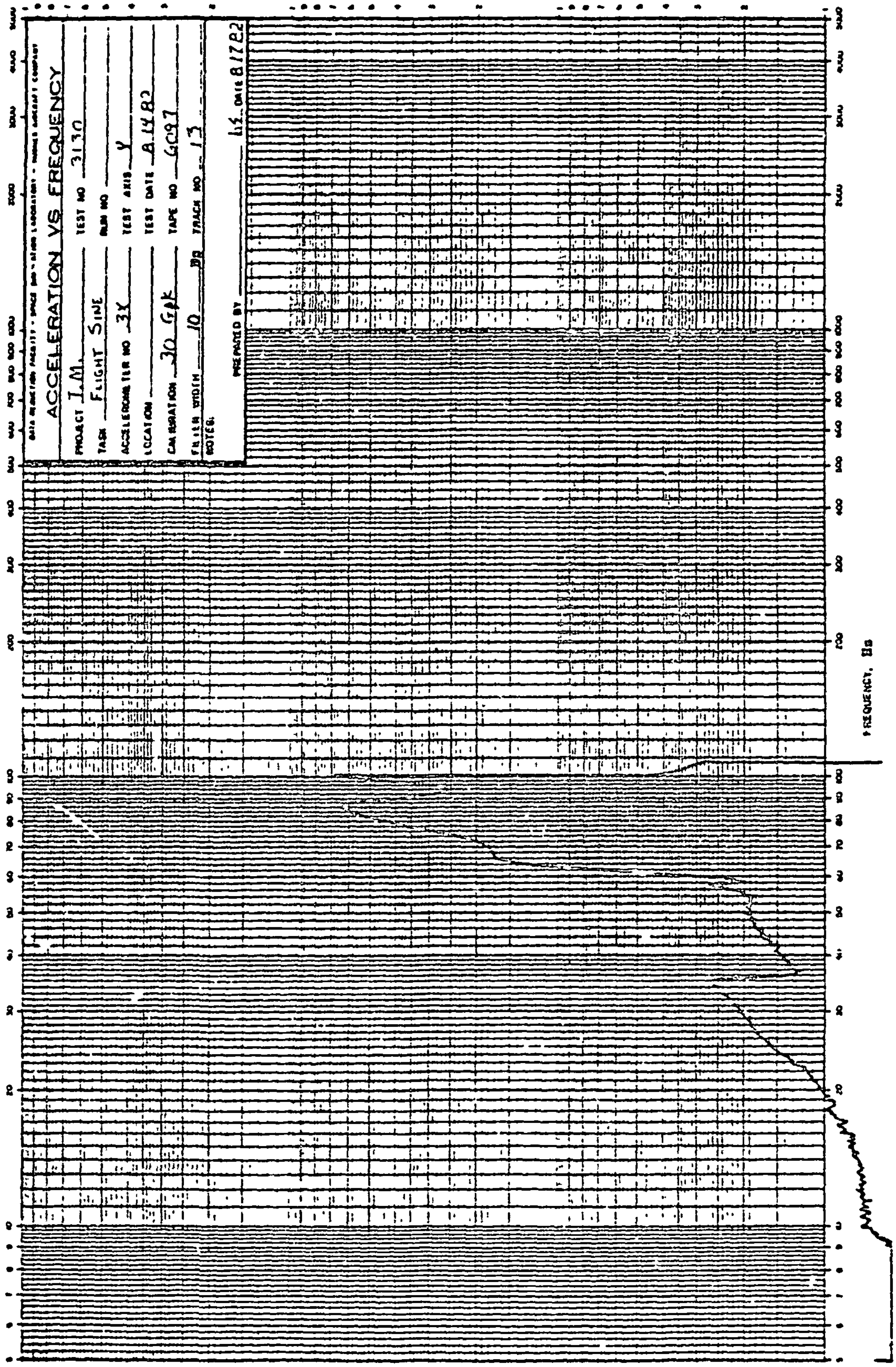

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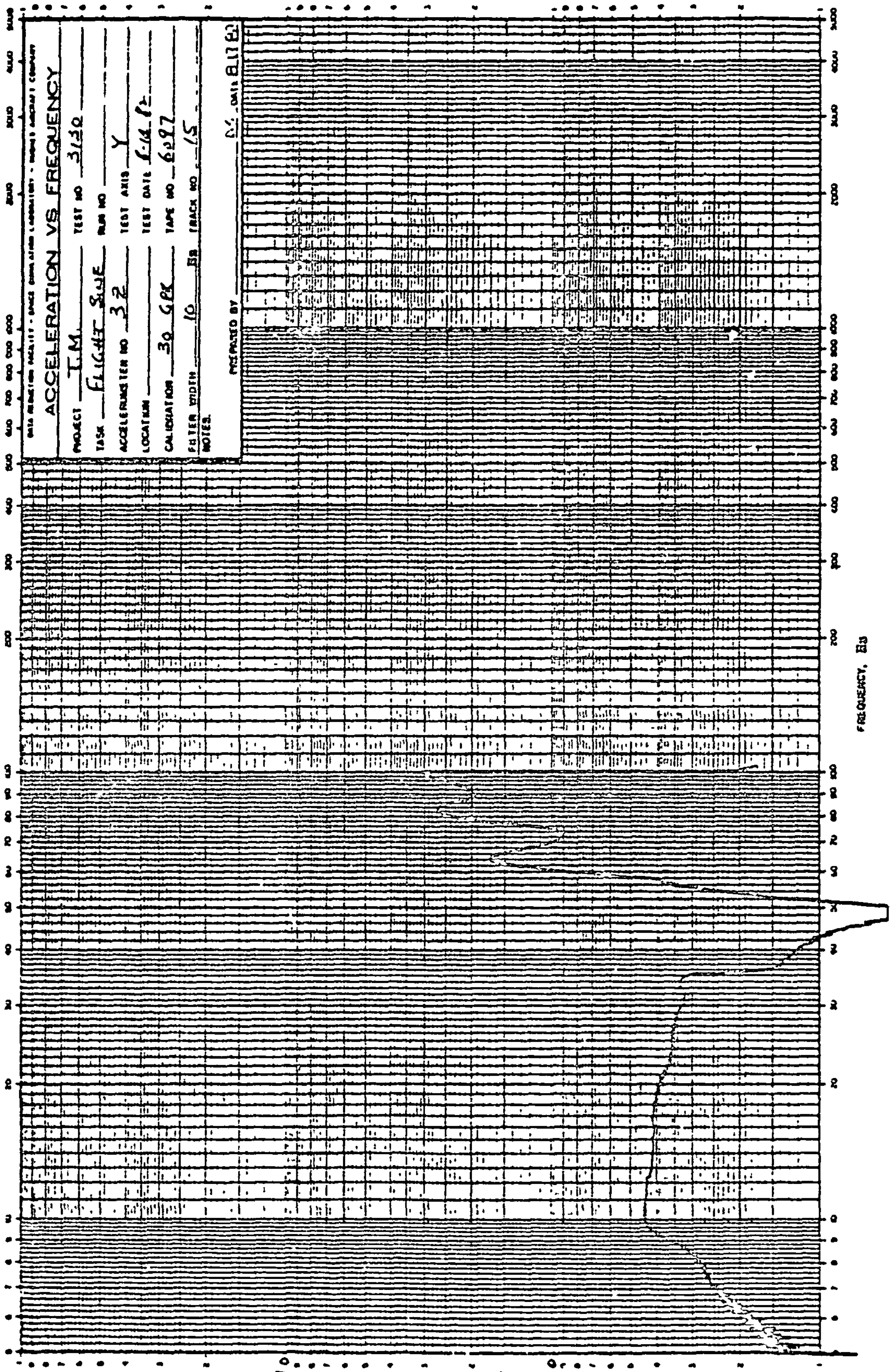

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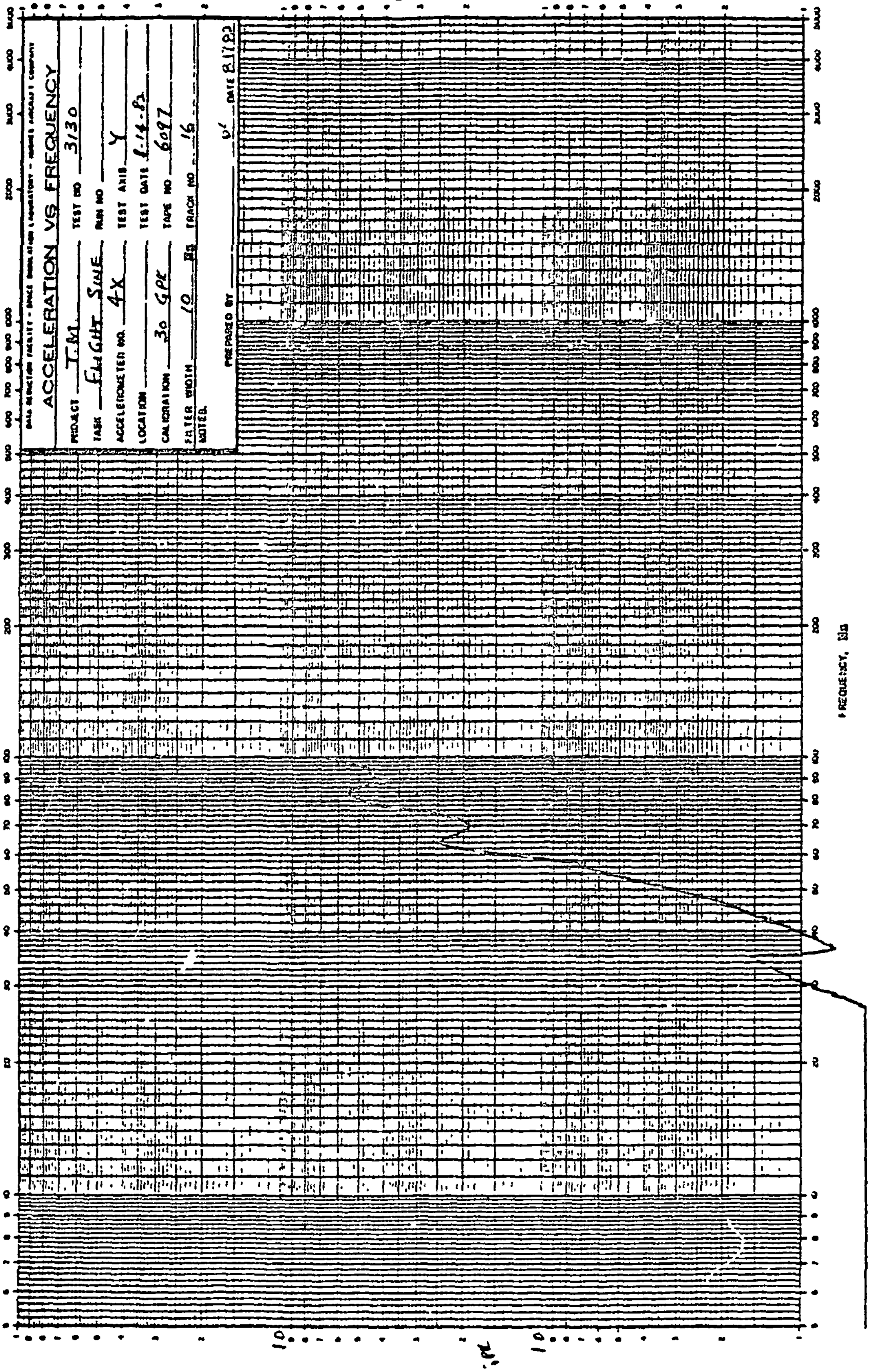

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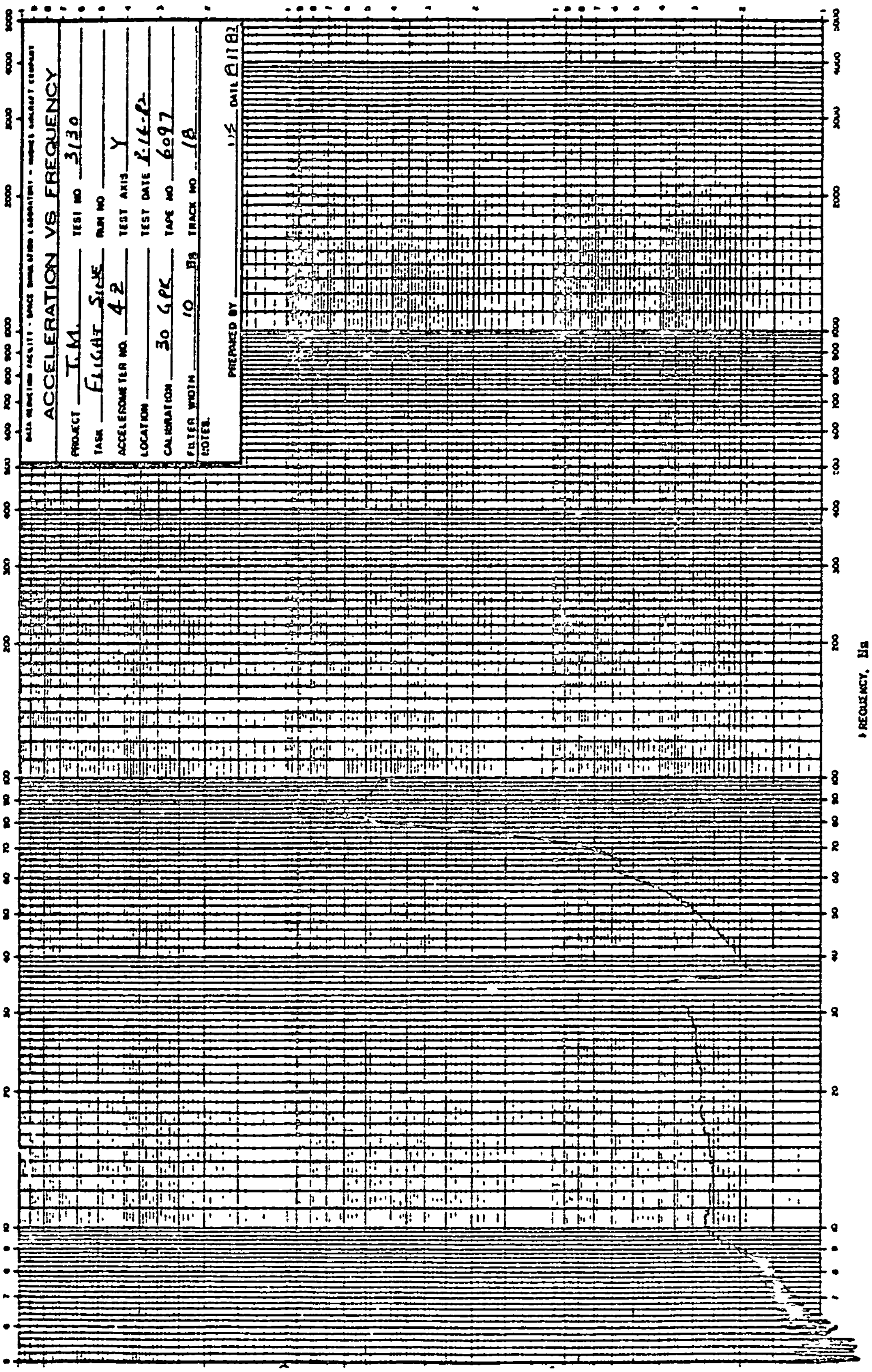

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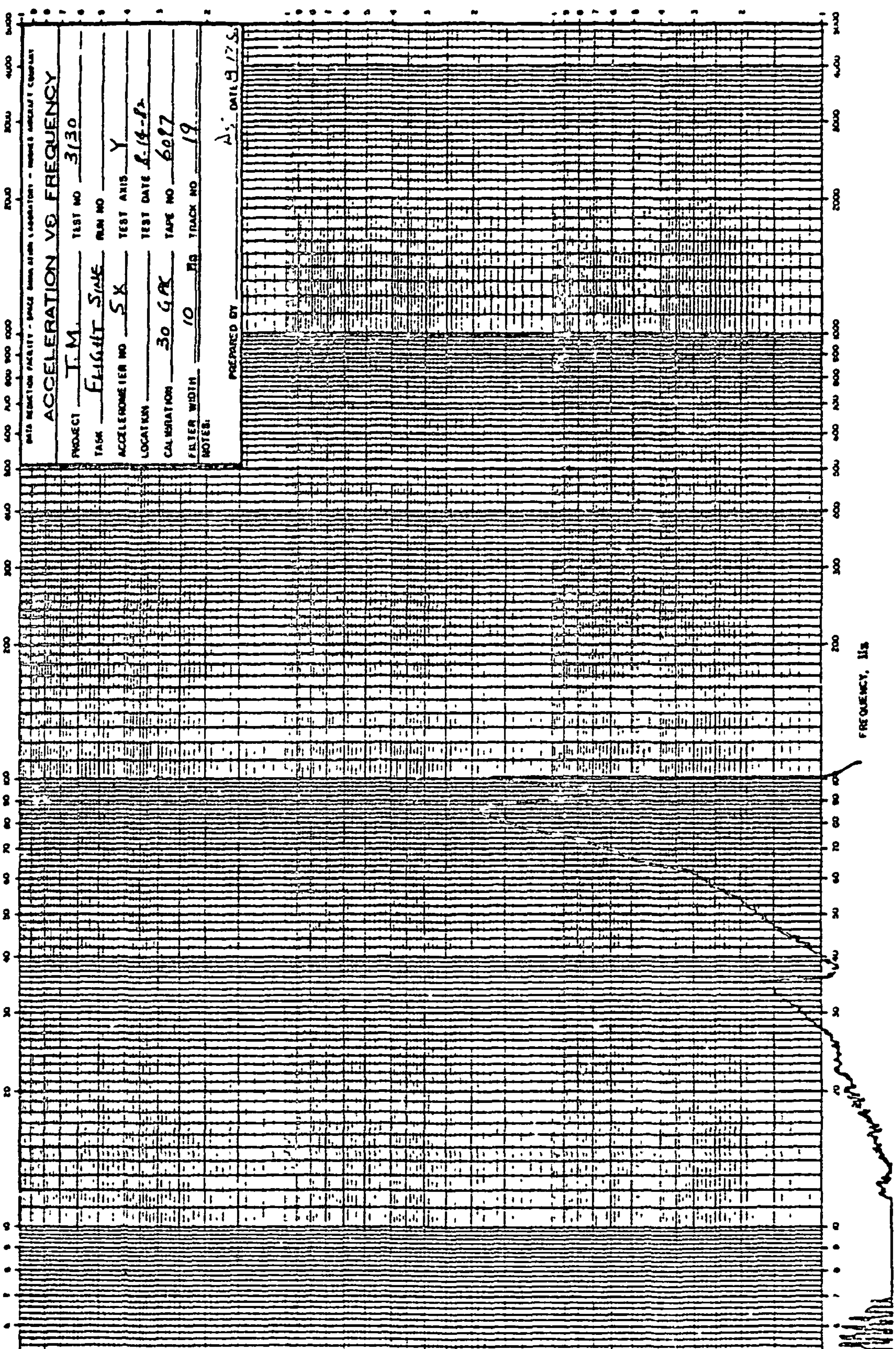

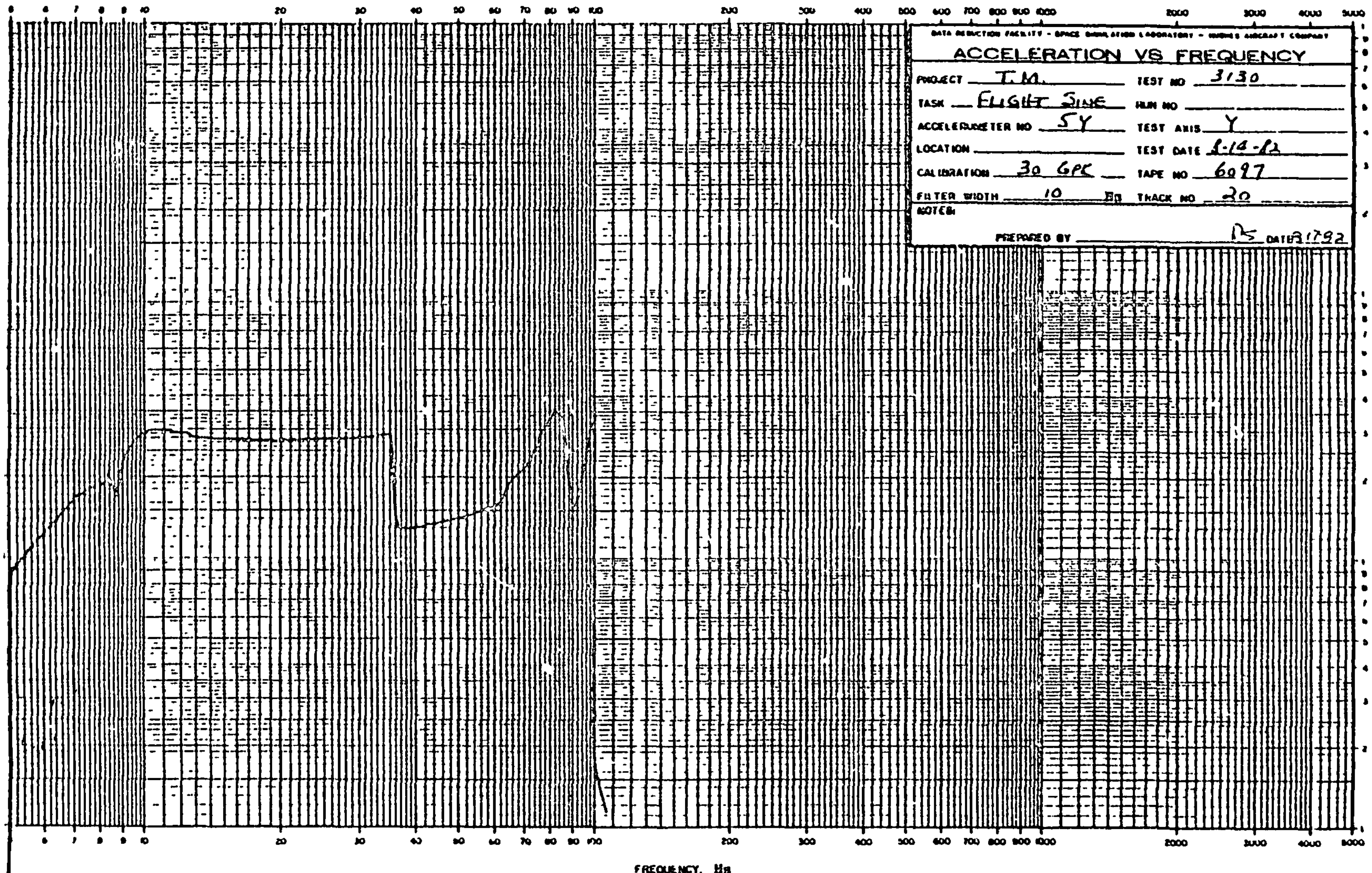

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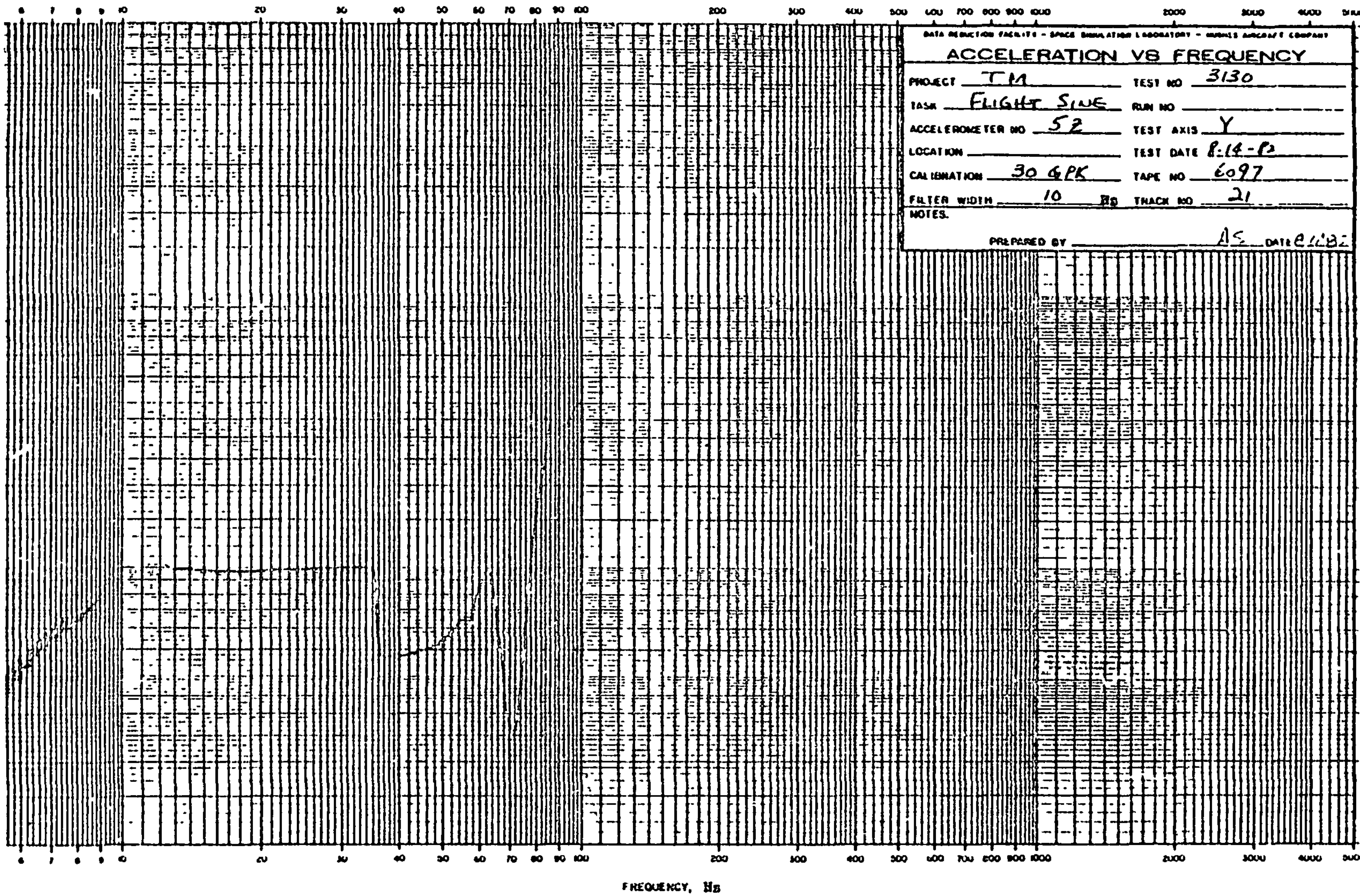

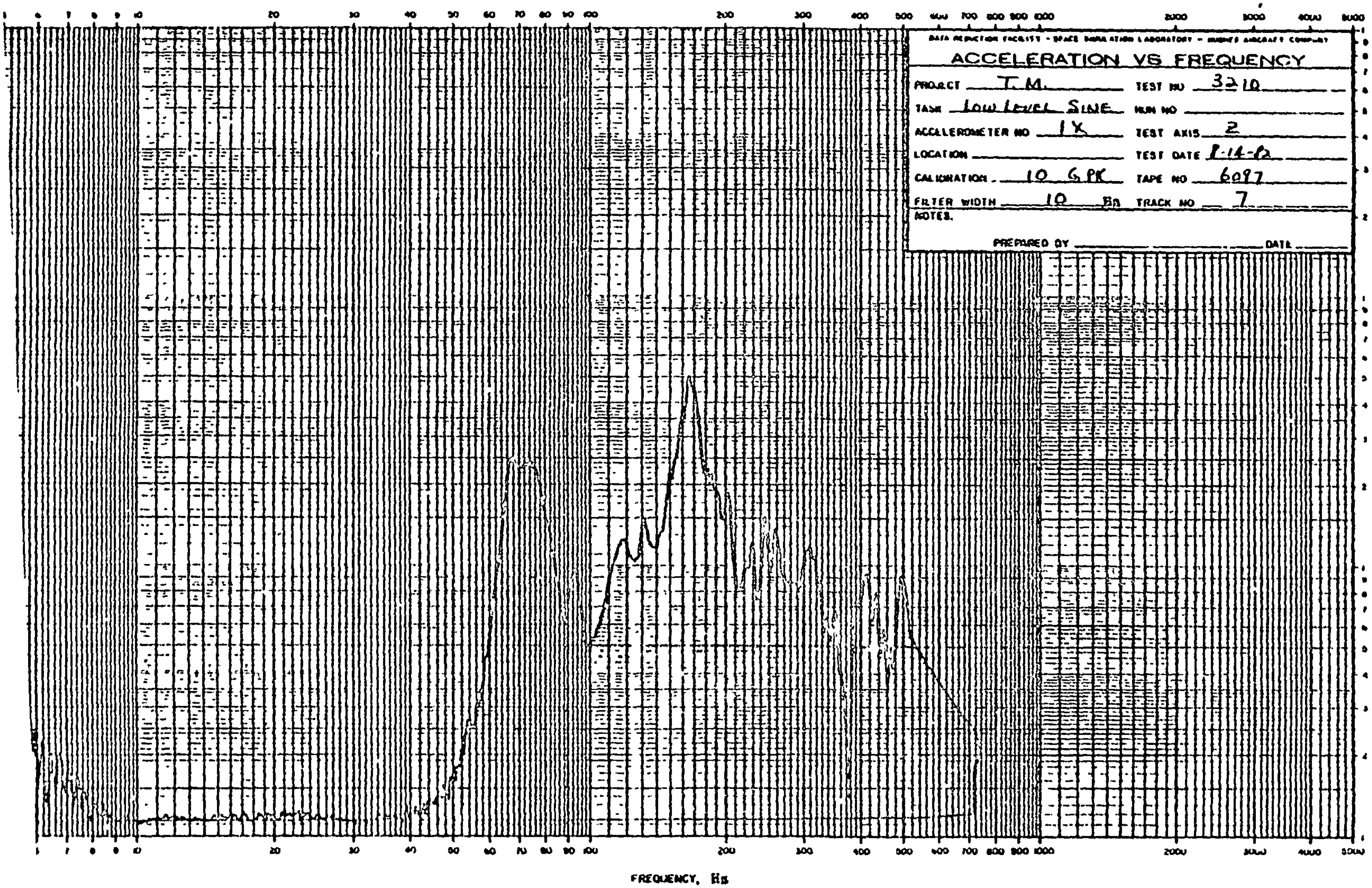

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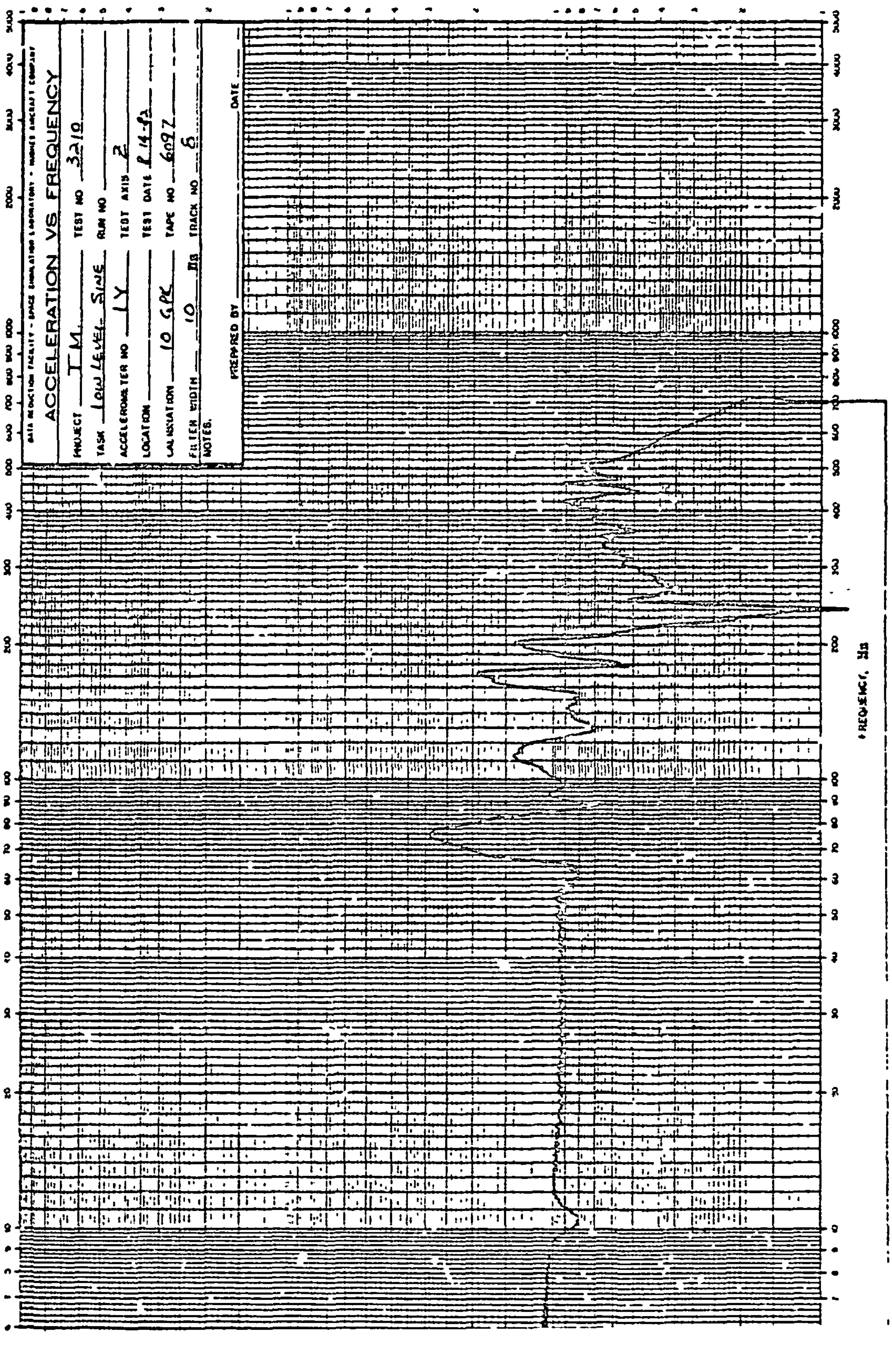

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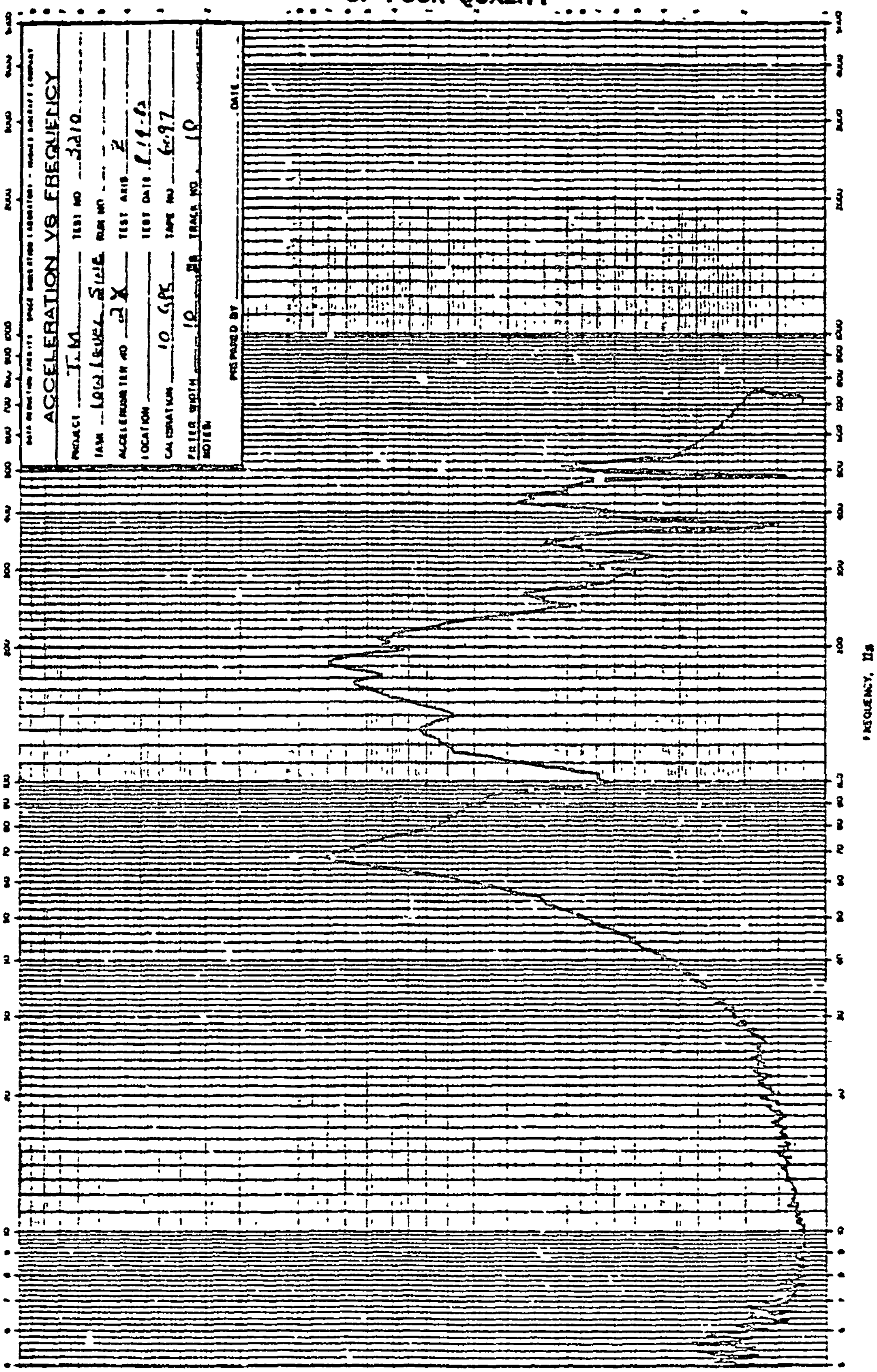

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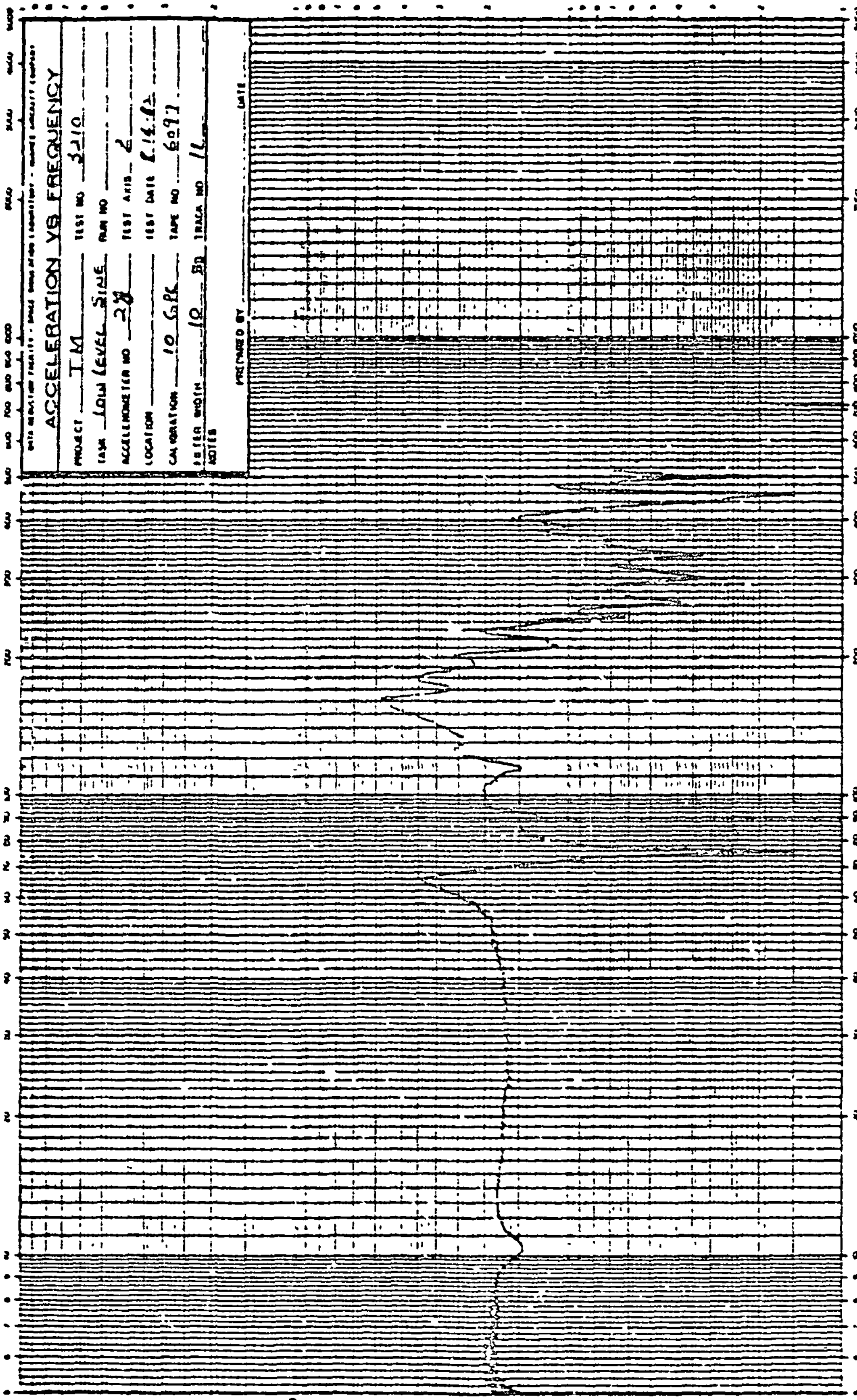

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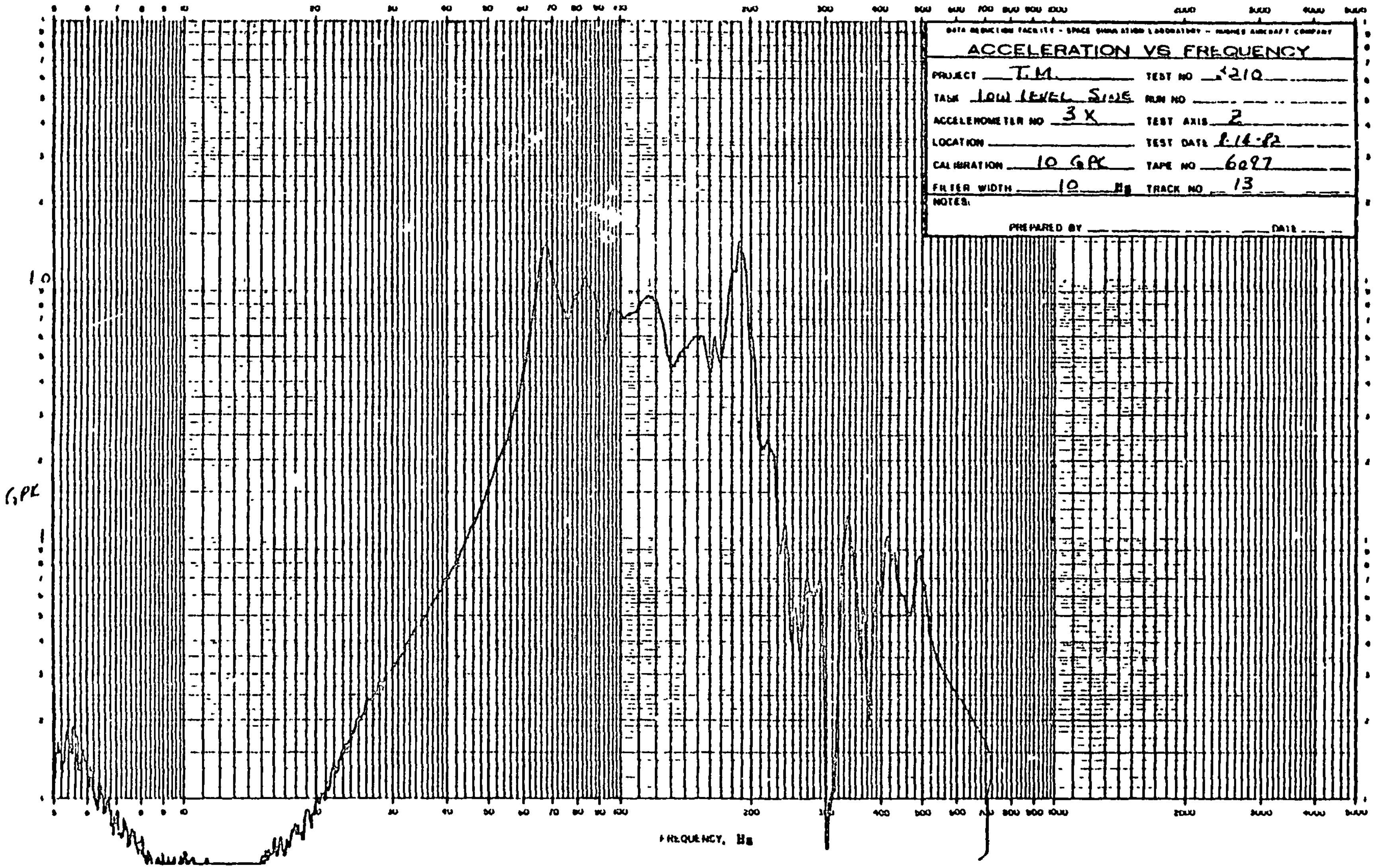

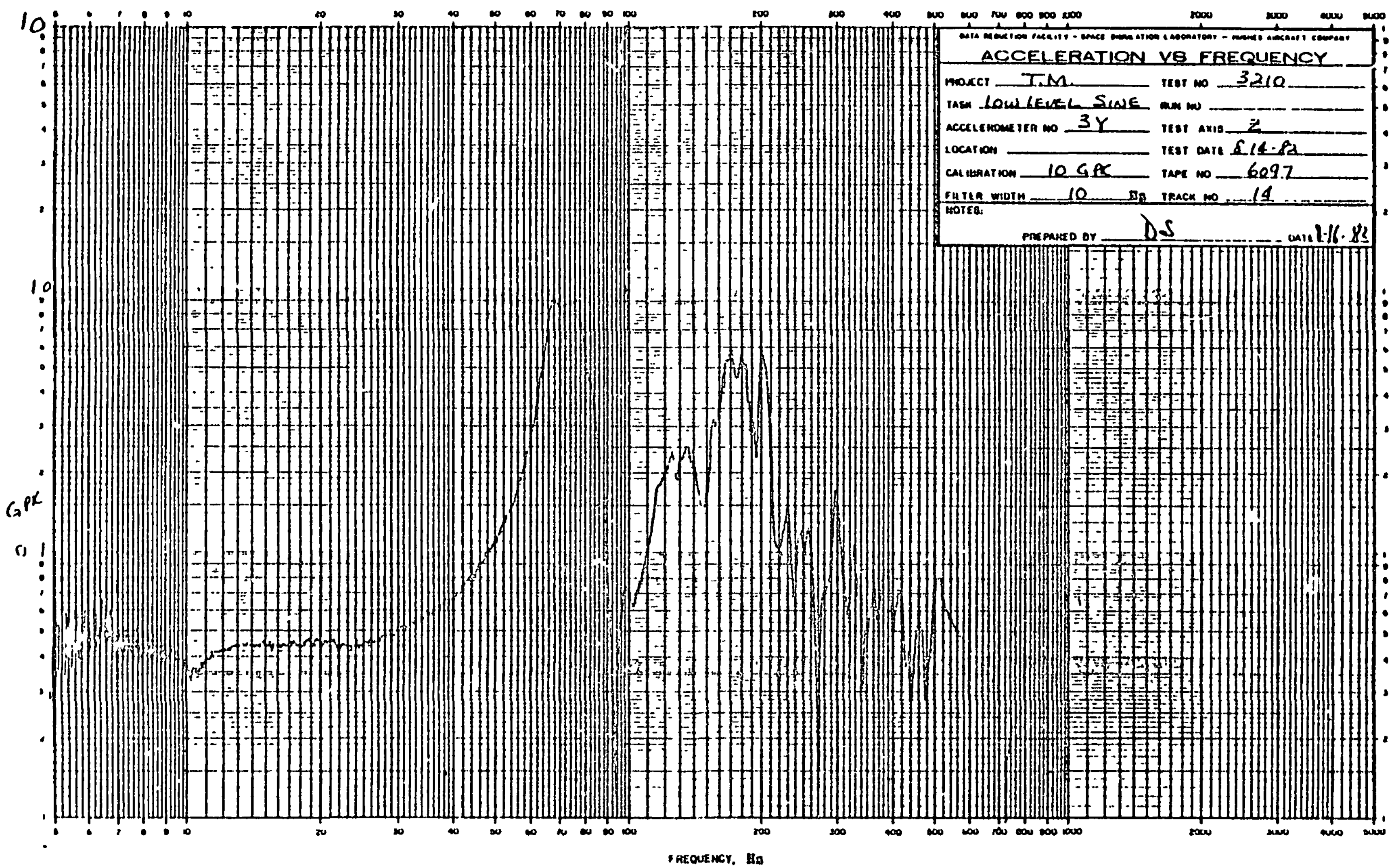

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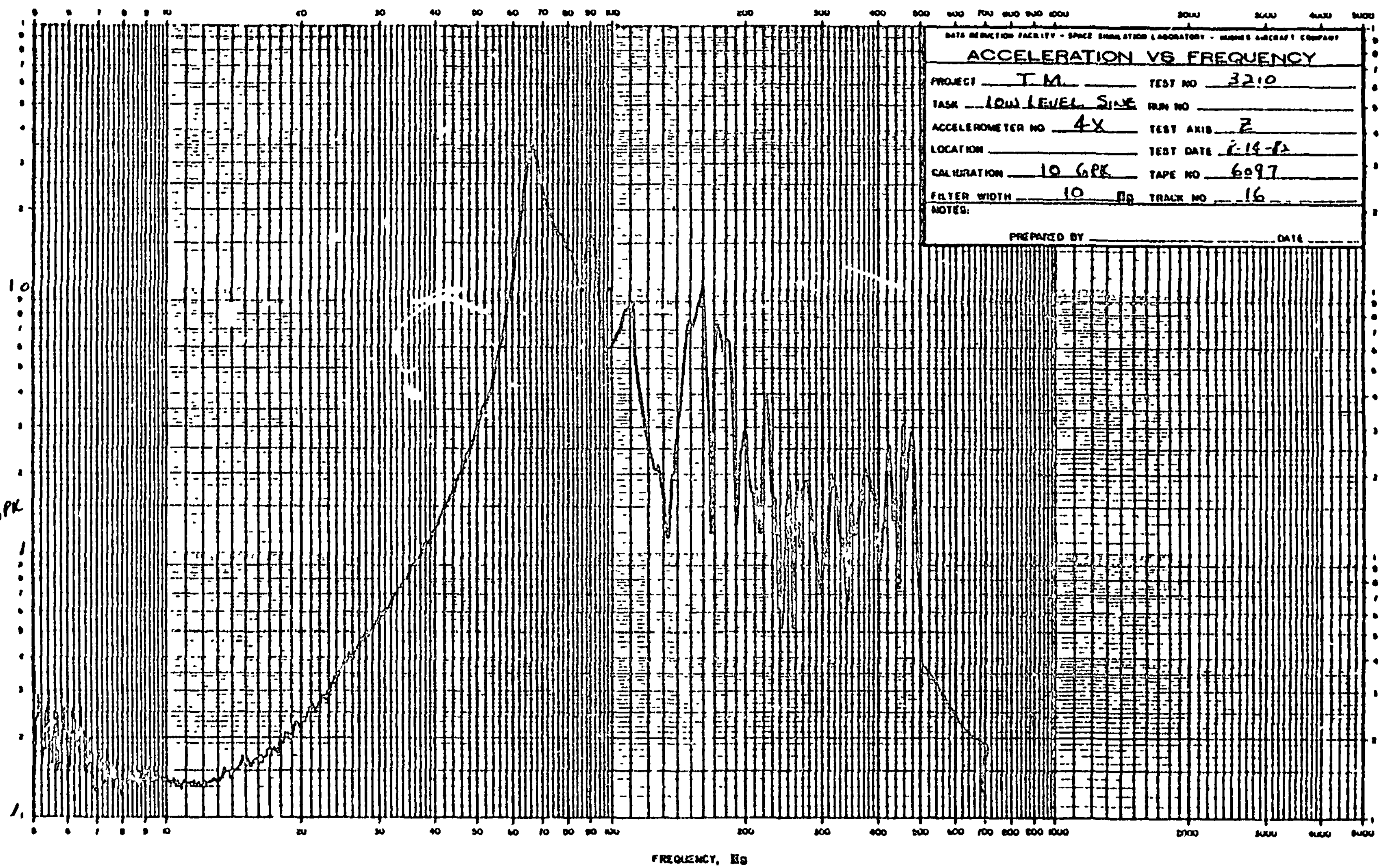

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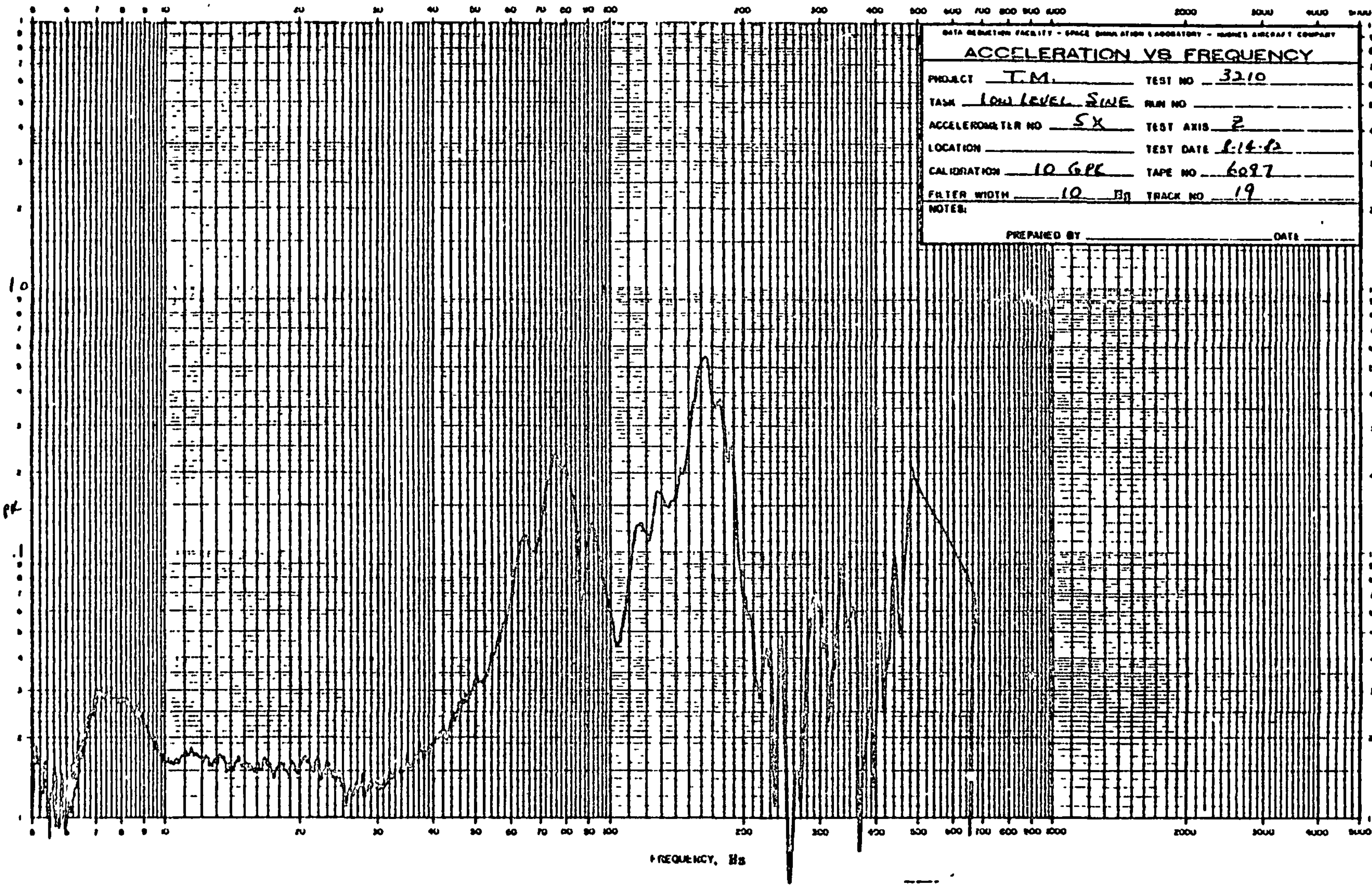

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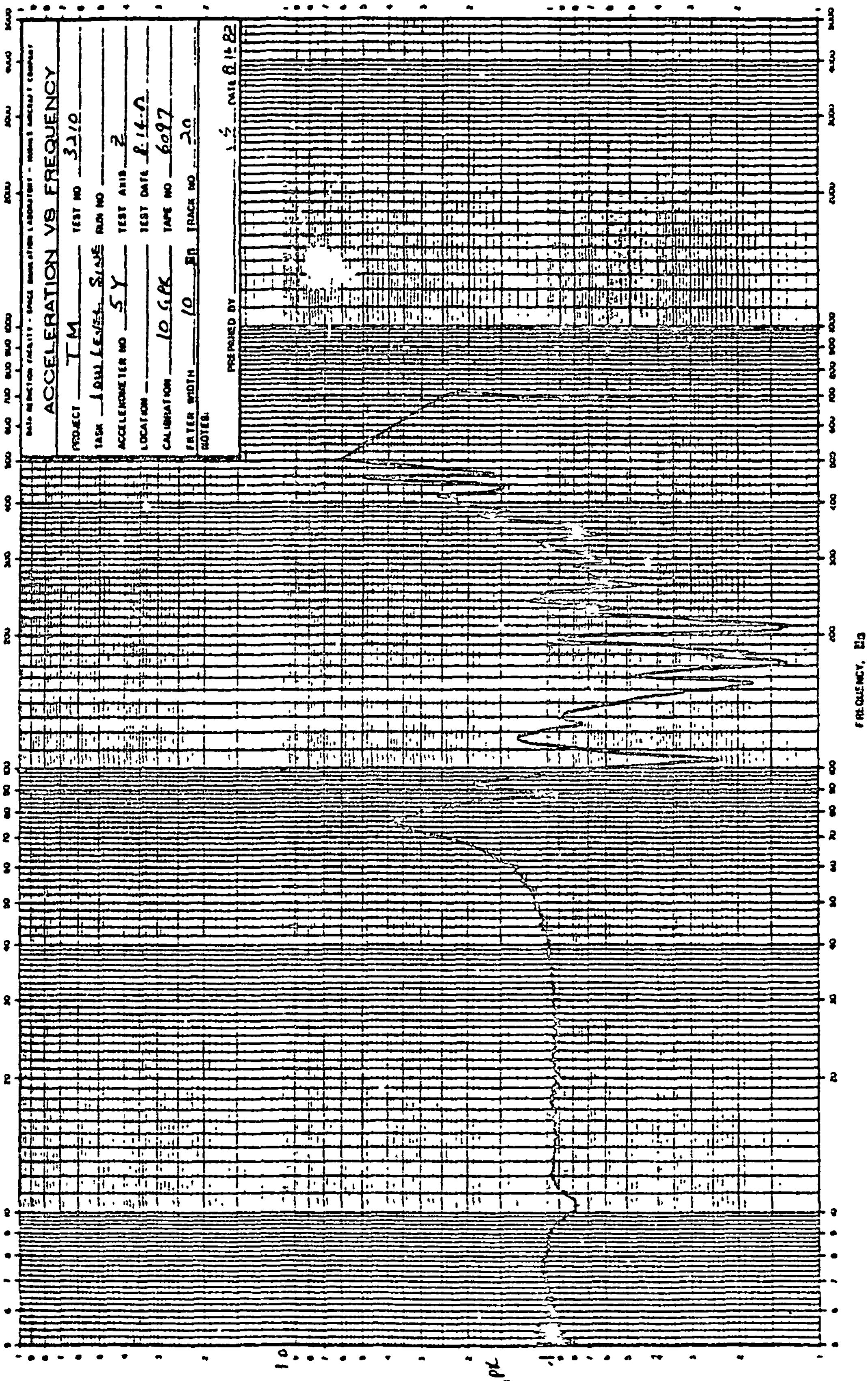

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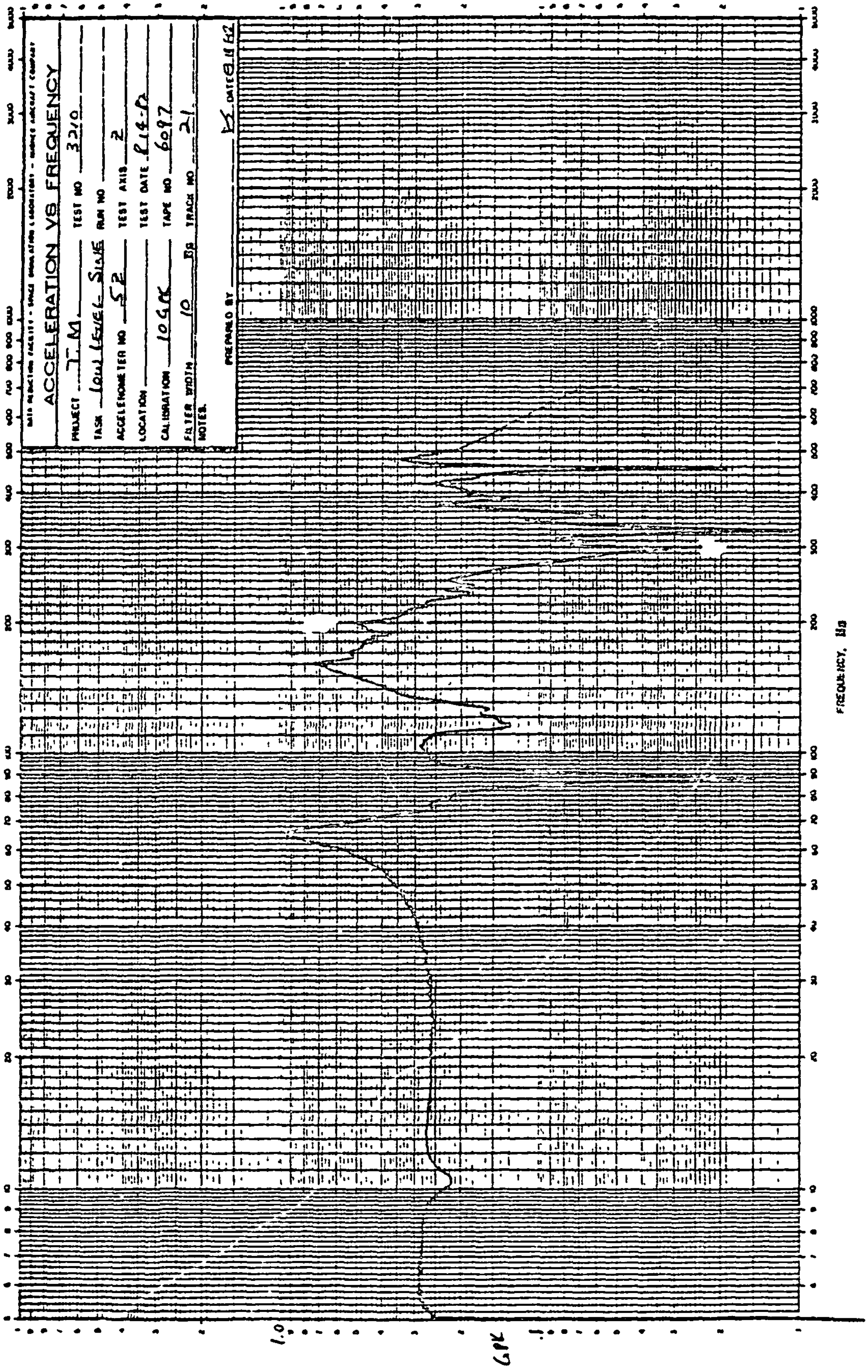

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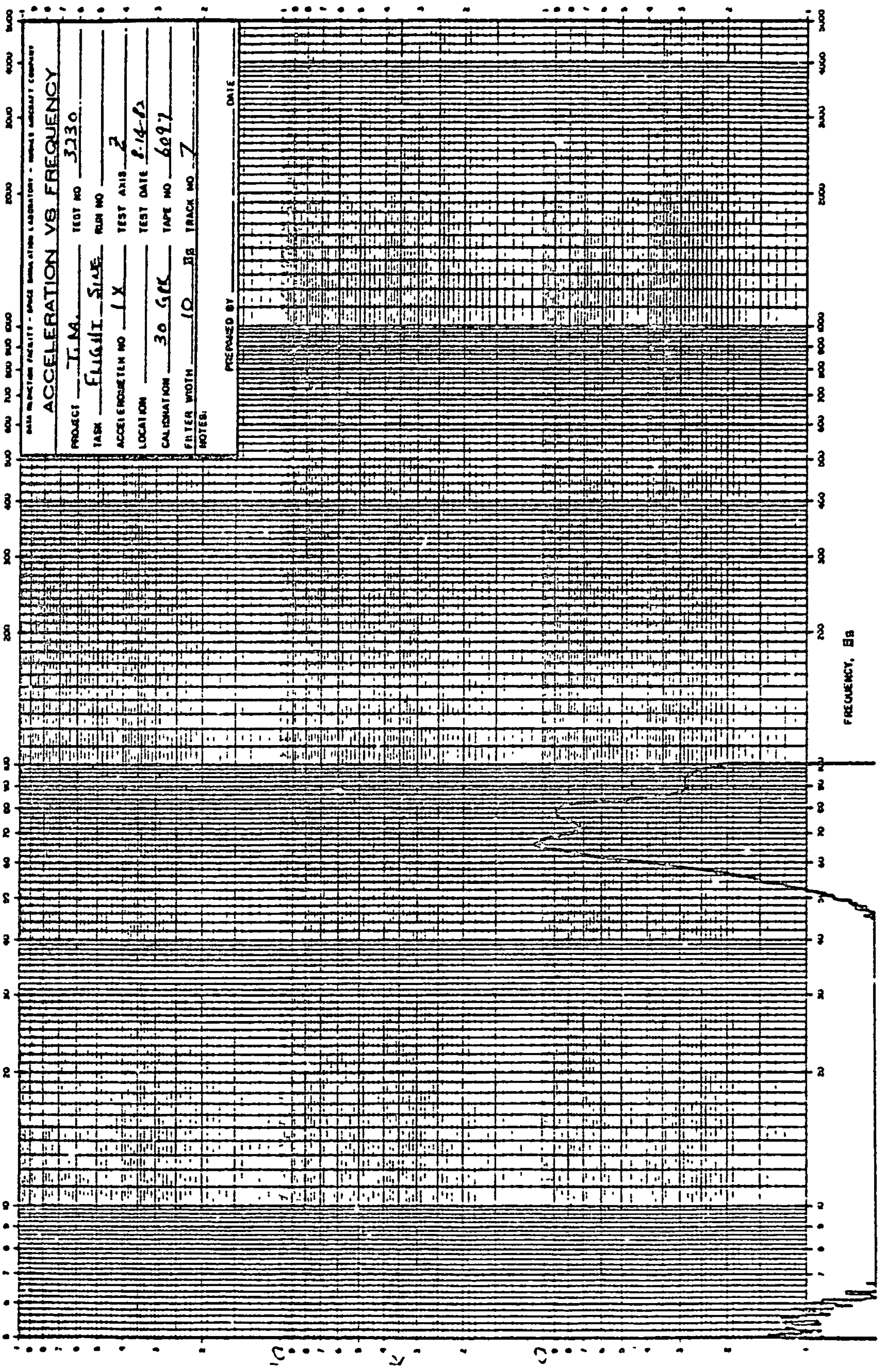

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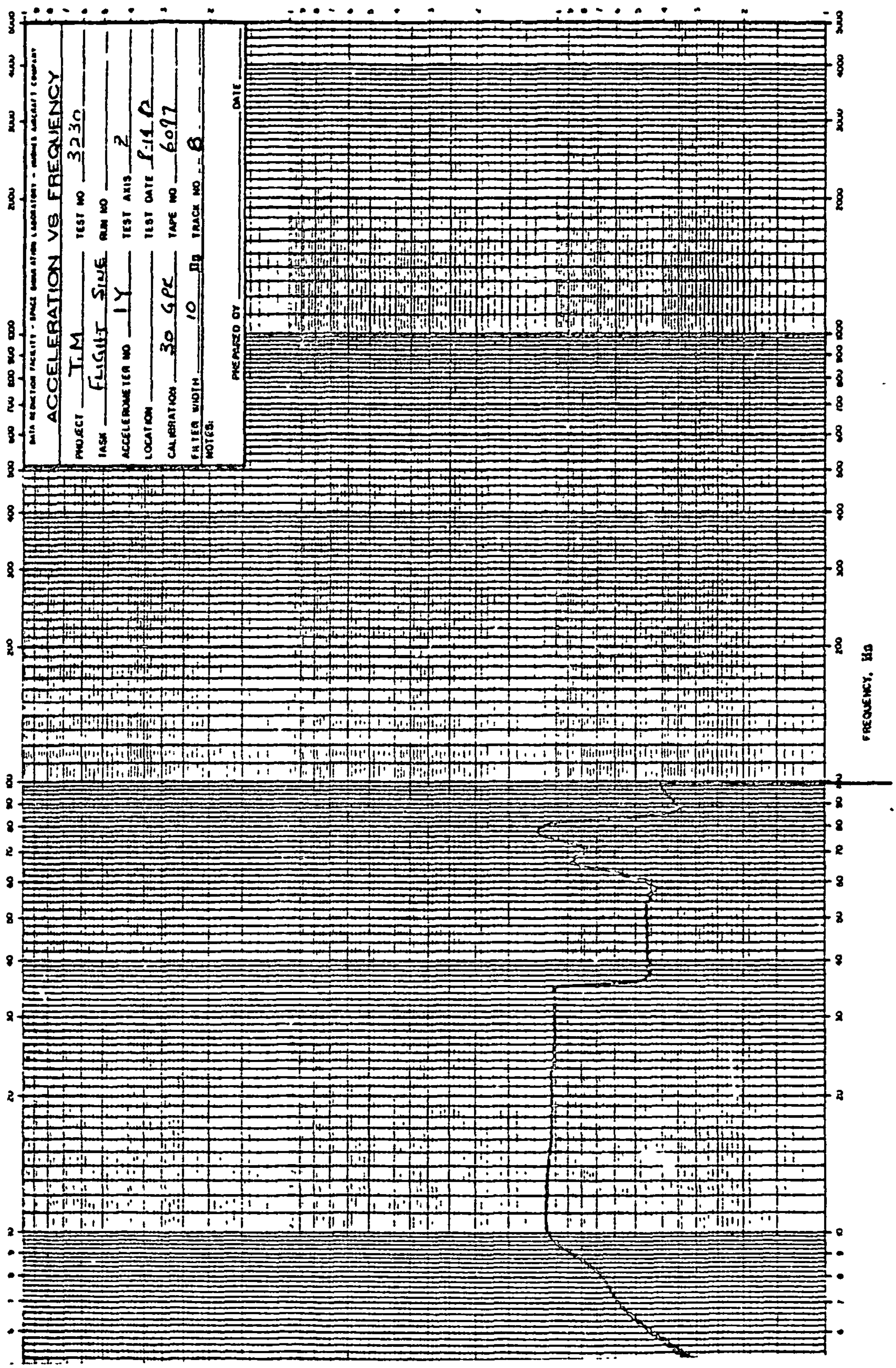

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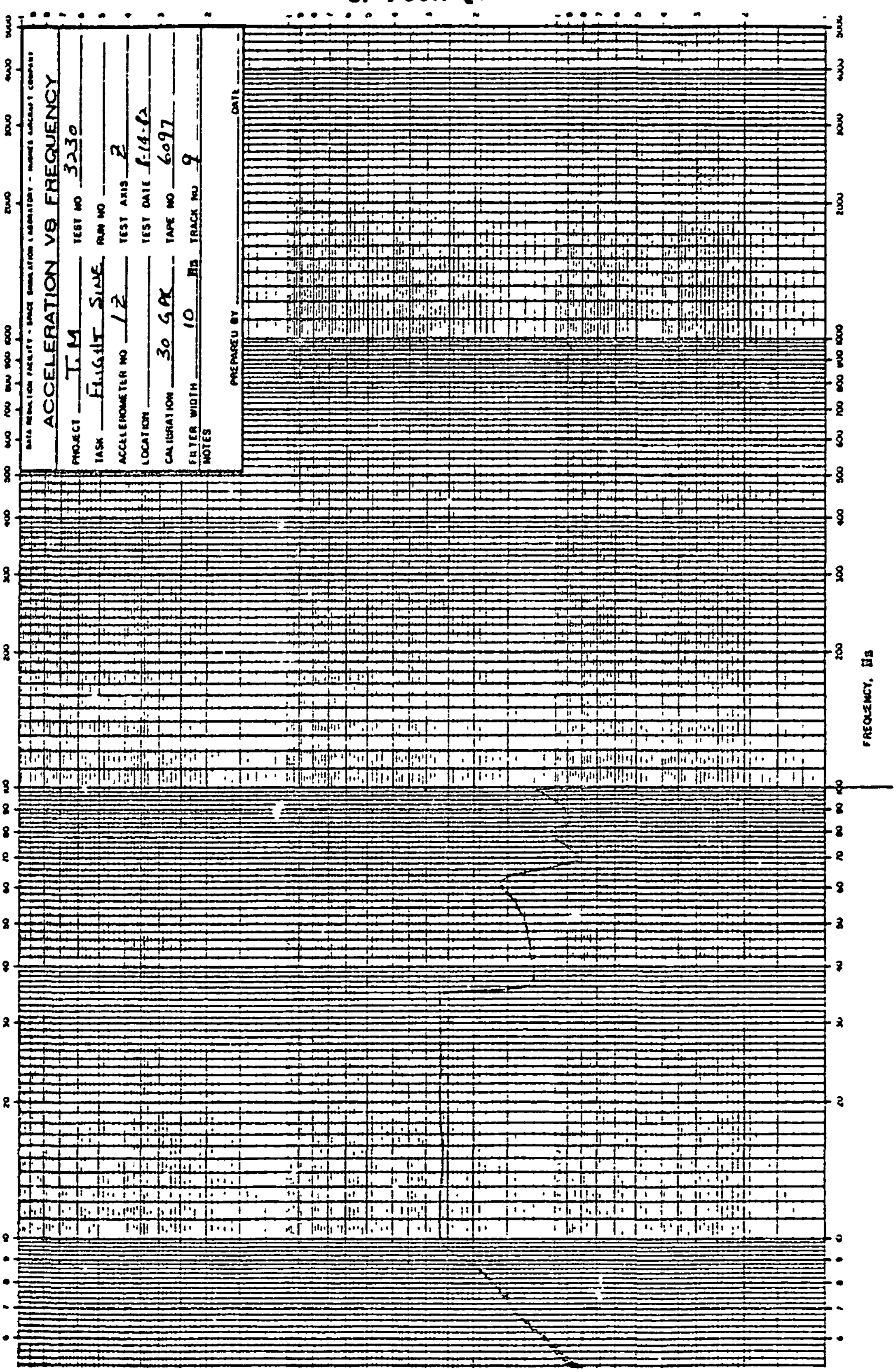

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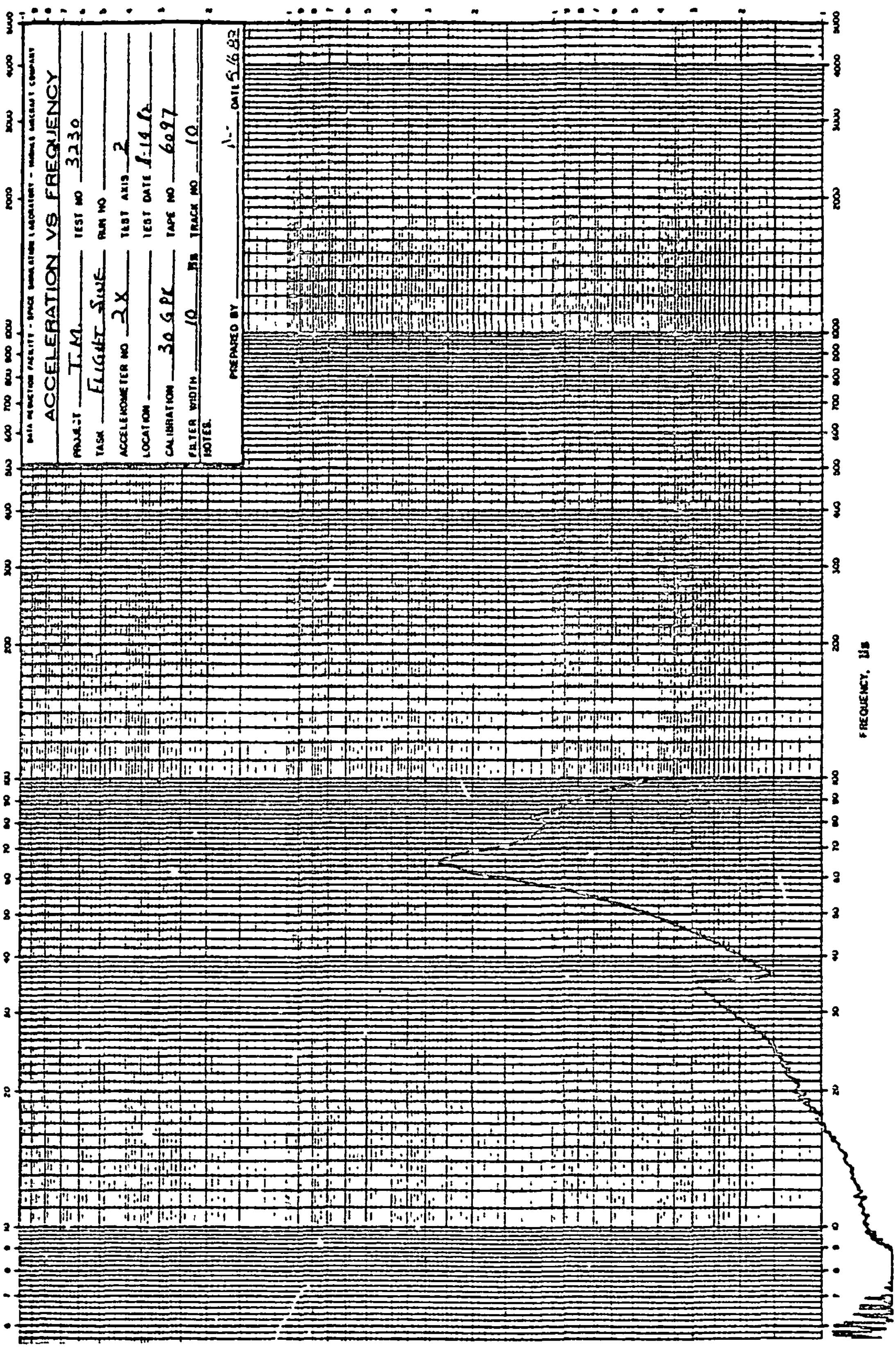

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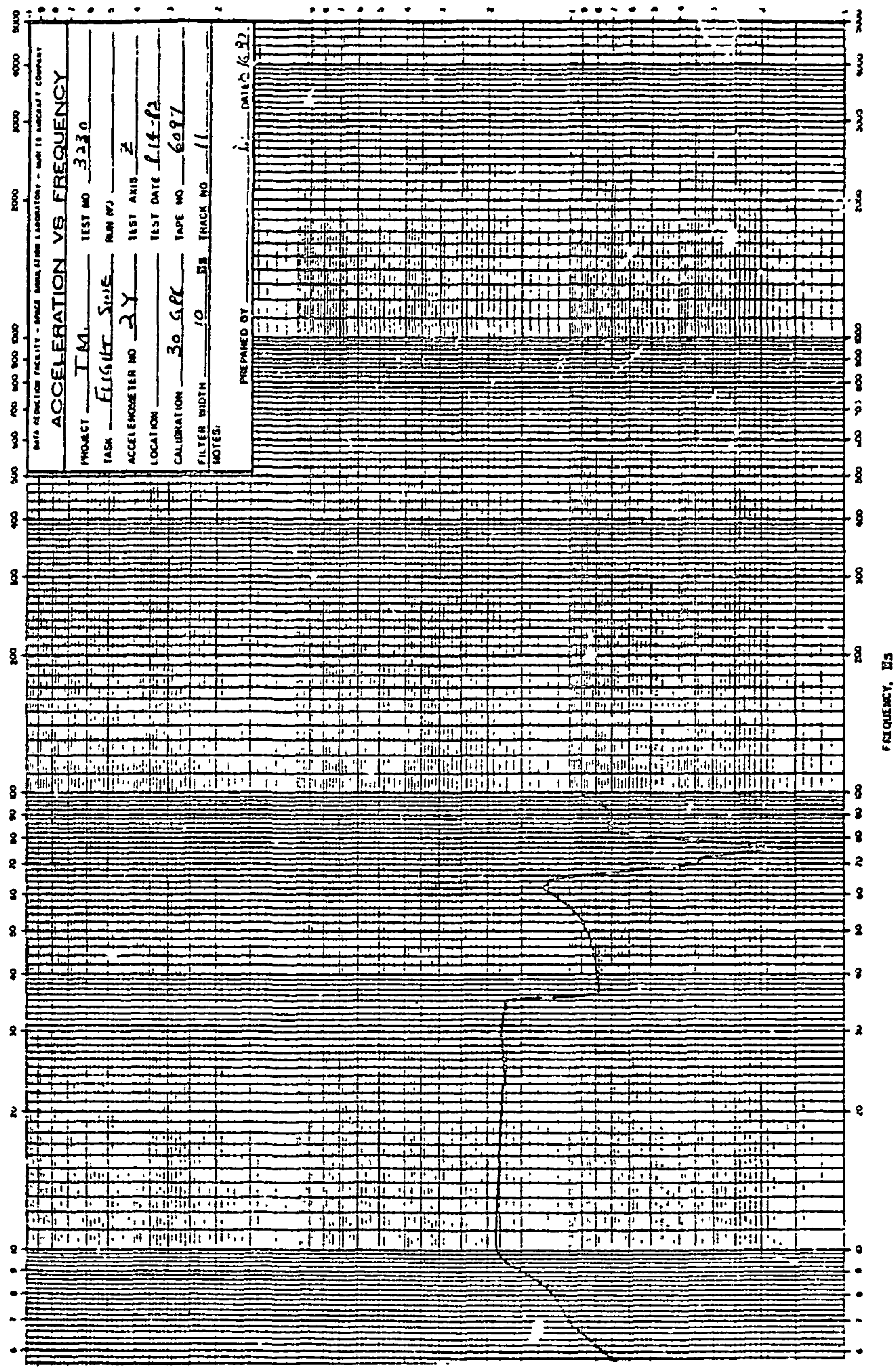

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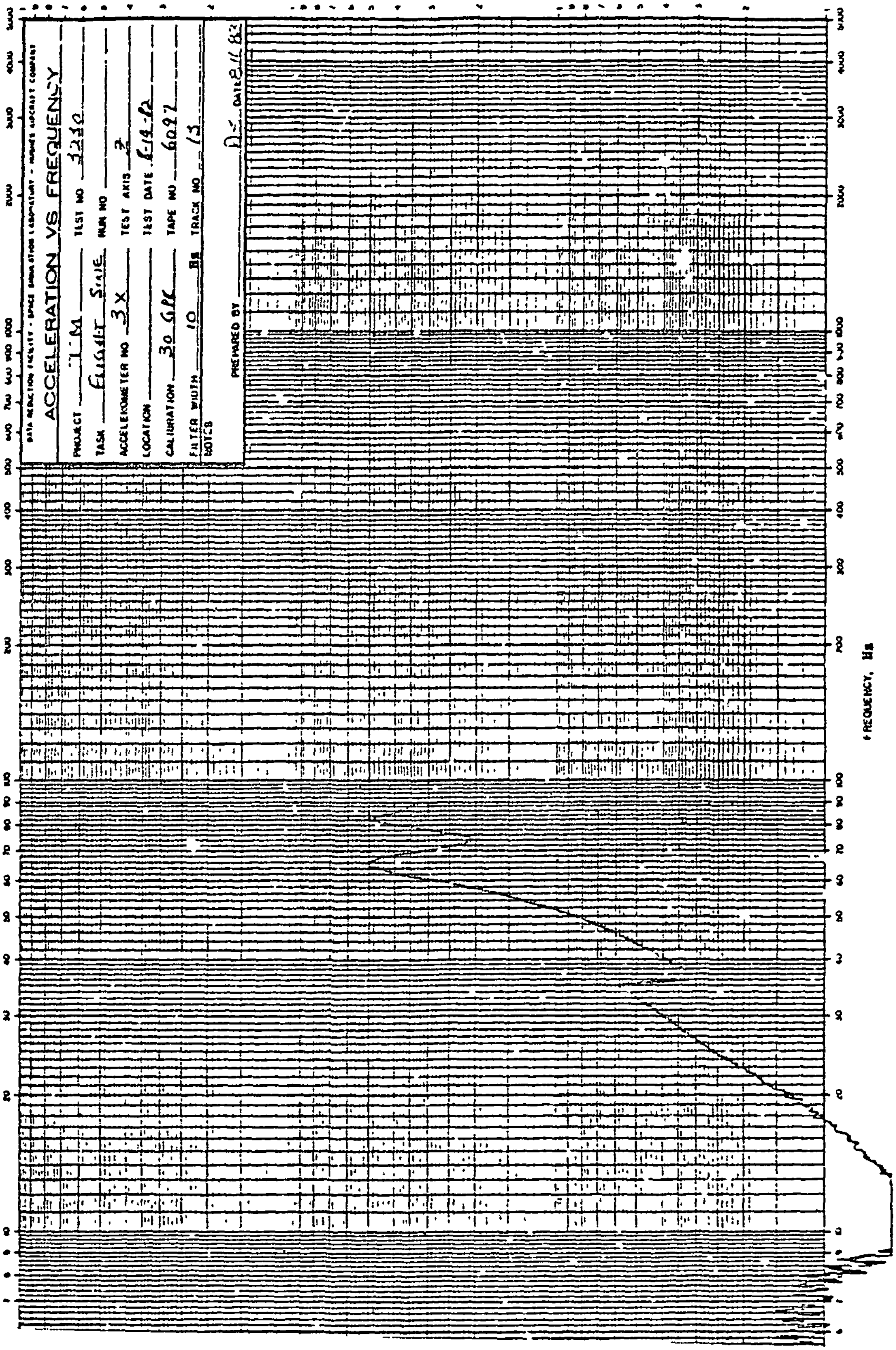

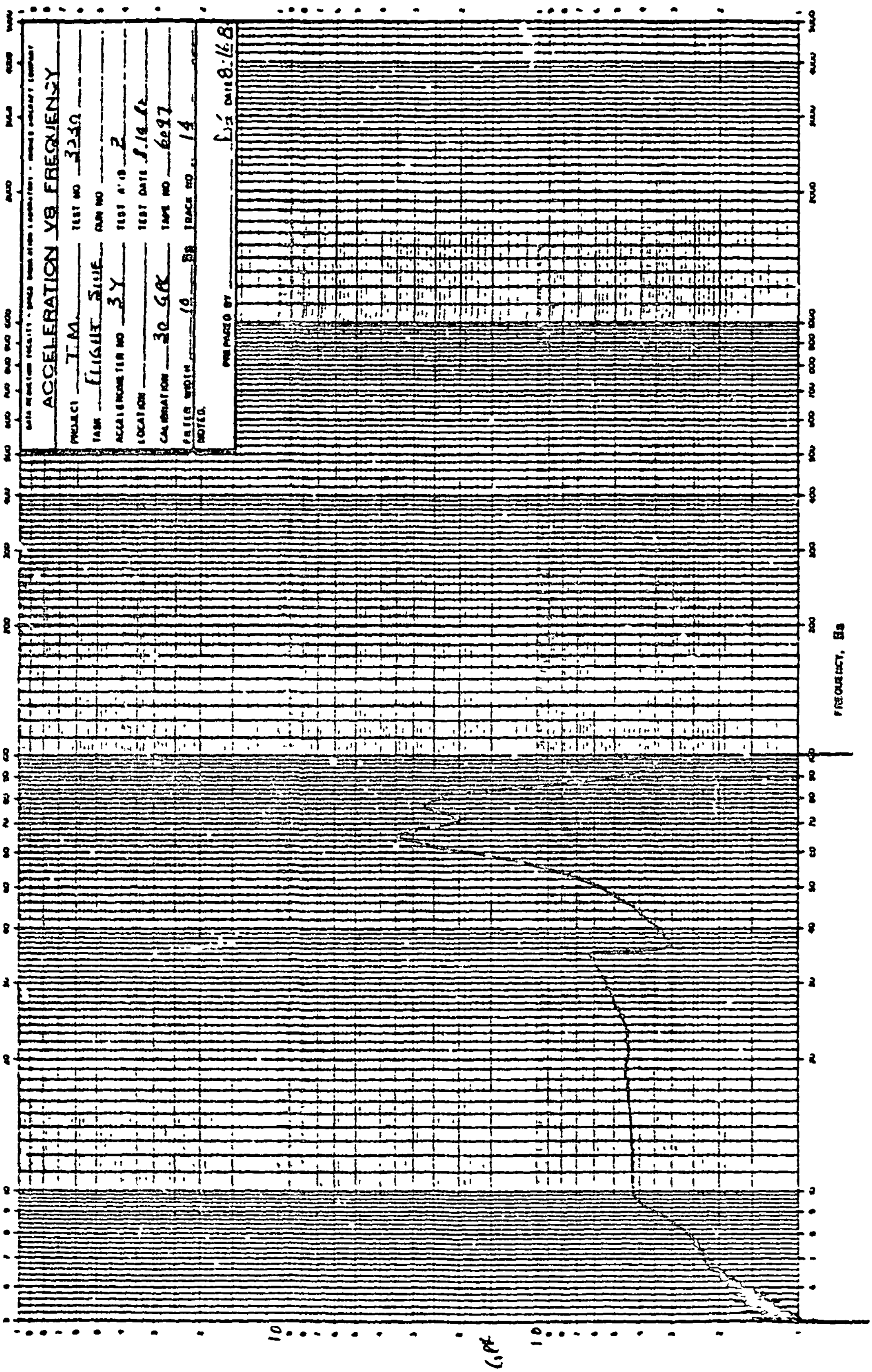
ACCELERATION VS FREQUENCY
PROJECT T.M.
TEST NO 3240
TASK Flight Sine
ACCELEROMETER NO 3Y
TEST AXIS 2
CALIBRATION 30 GPK
TAPE NO 6097
TRACK NO 14
PREPARED BY
FREQUENCY, Hz

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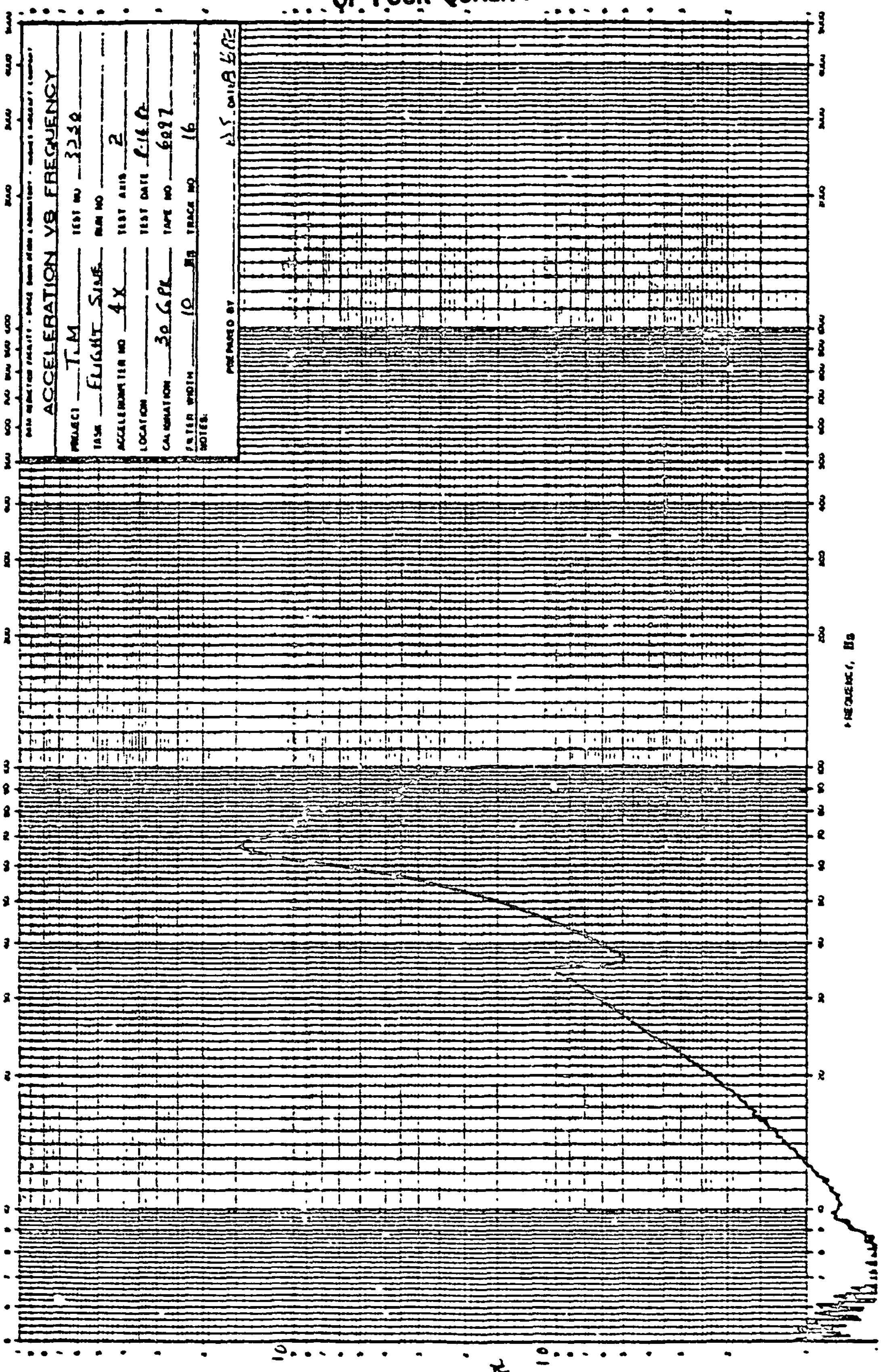

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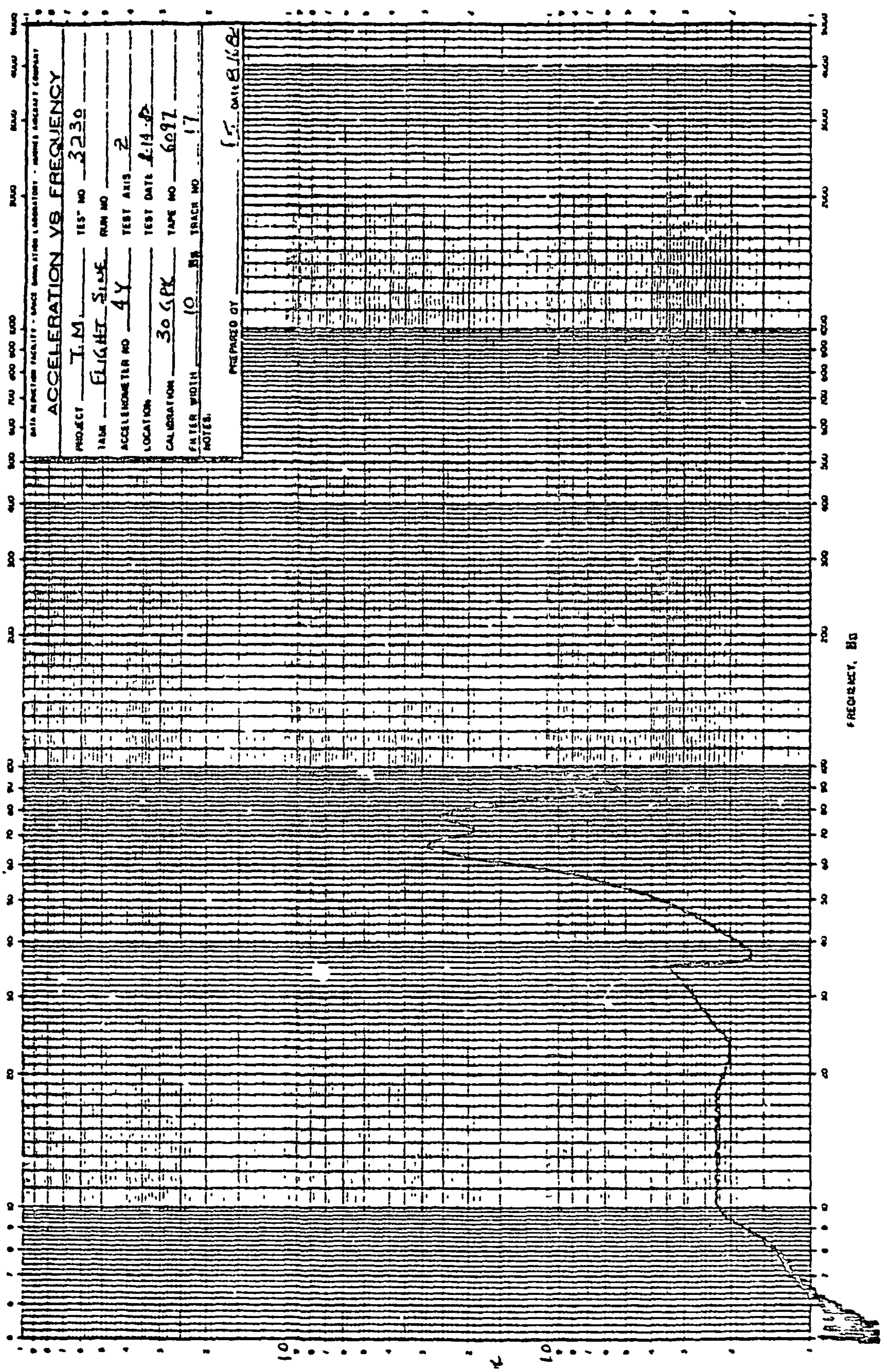

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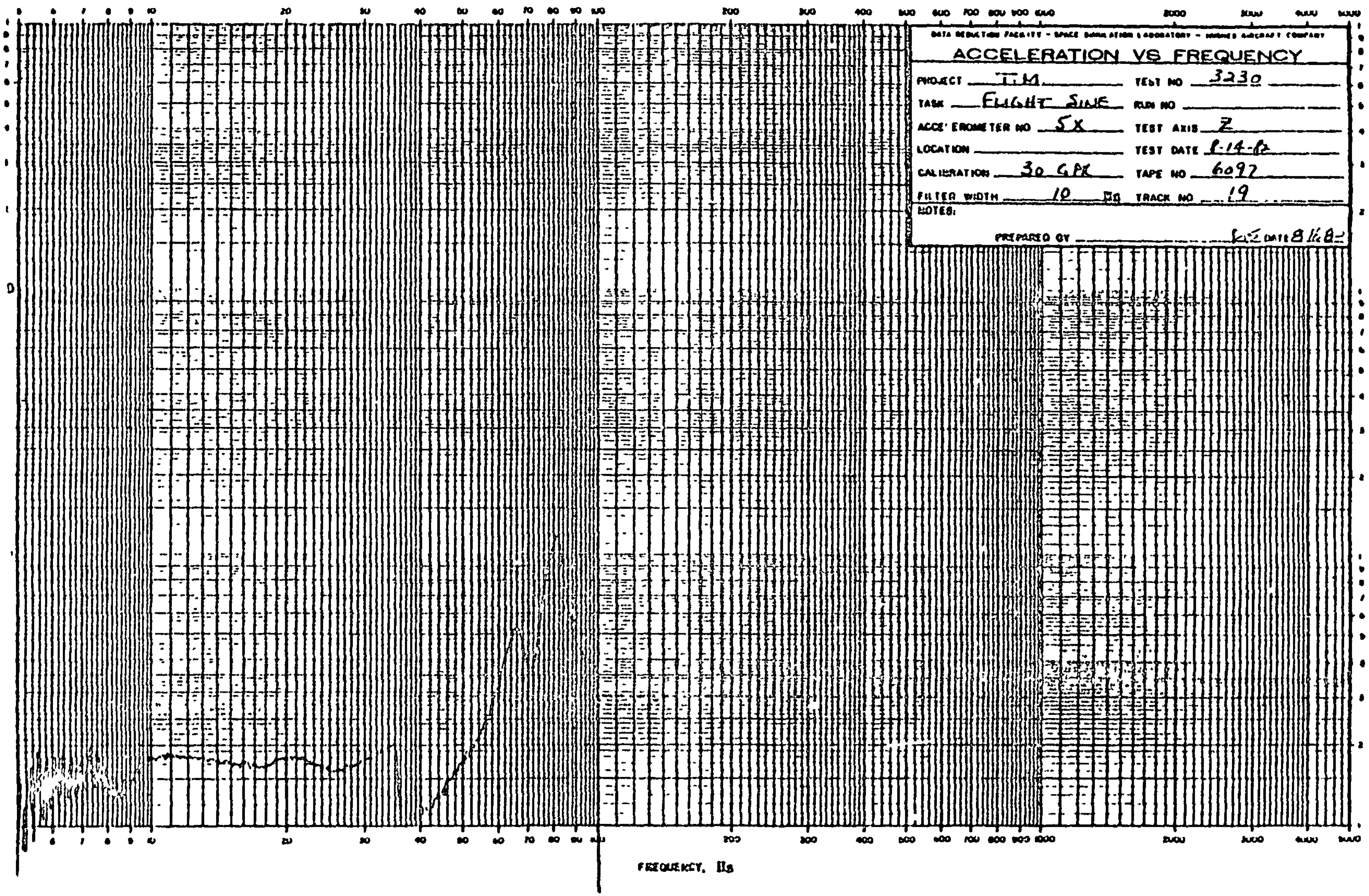

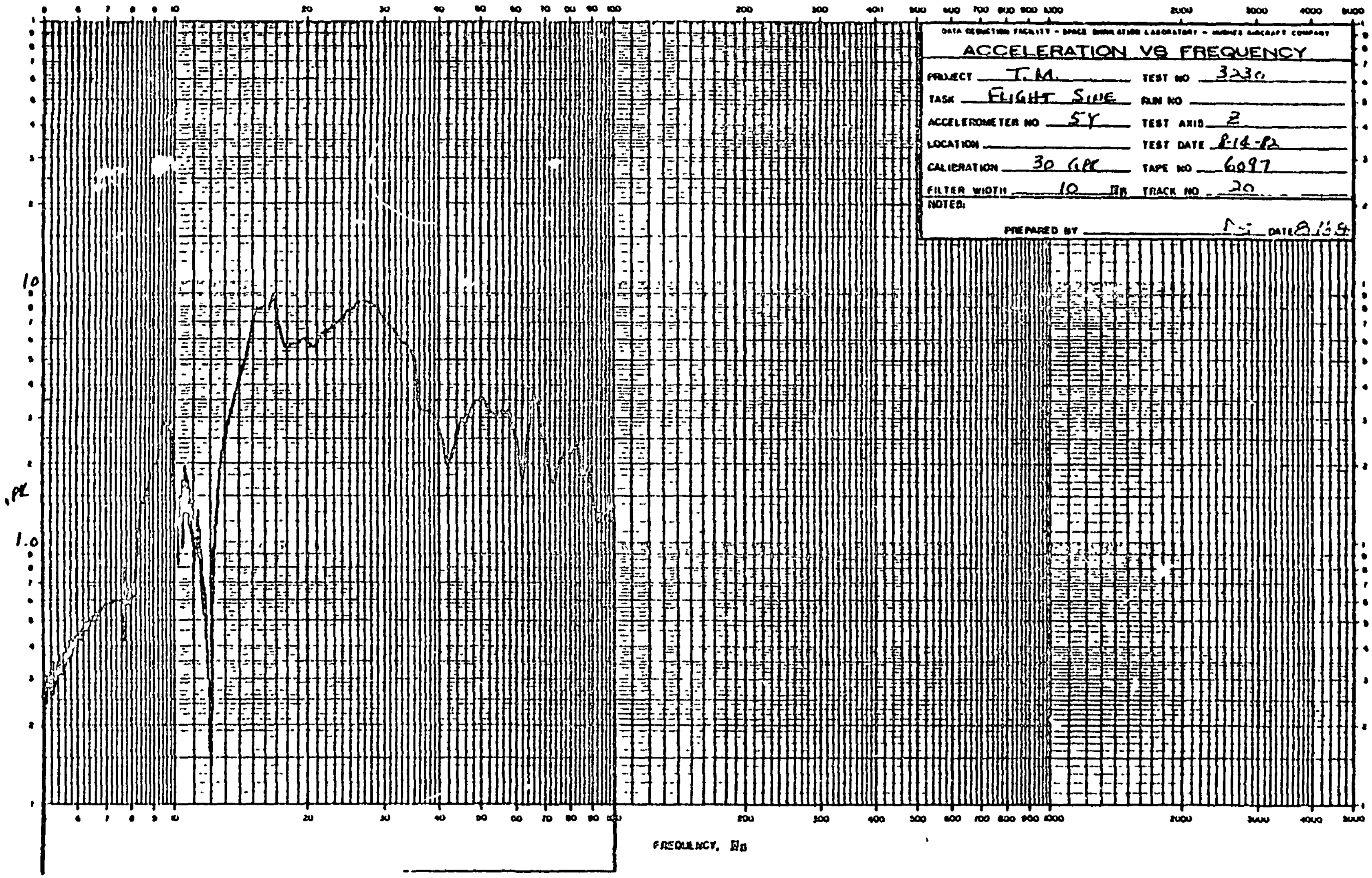
DATA REDUCTION FACILITY - SPACE SIMULATION LABORATORY - HUGHES AIRCRAFT COMPANY
ACCELERATION VS FREQUENCY
PROJECT T.M.
TEST NO 3230
TASK FLIGHT SINE
RUN NO
ACCELEROMETER NO 5Y
TEST AXIS Z
LOCATION
TEST DATE 8-14-82
CALIBRATION 30 GPK
TAPE NO 6097
FILTER WIDTH 10 Hz
TRACK NO 20
NOTES:
PREPARED BY
DATE
FREQUENCY, Hz
10
1.0
,PK

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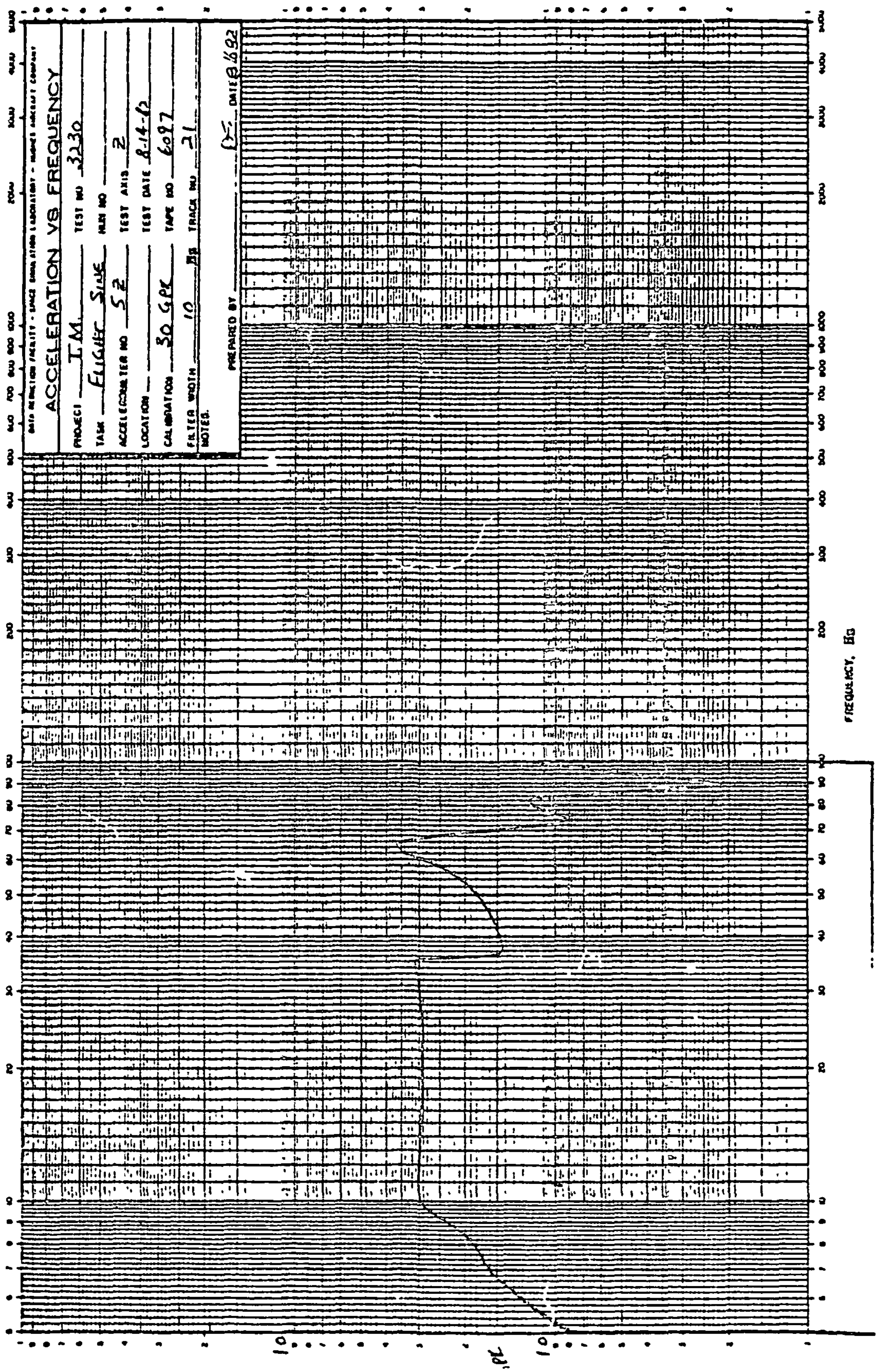

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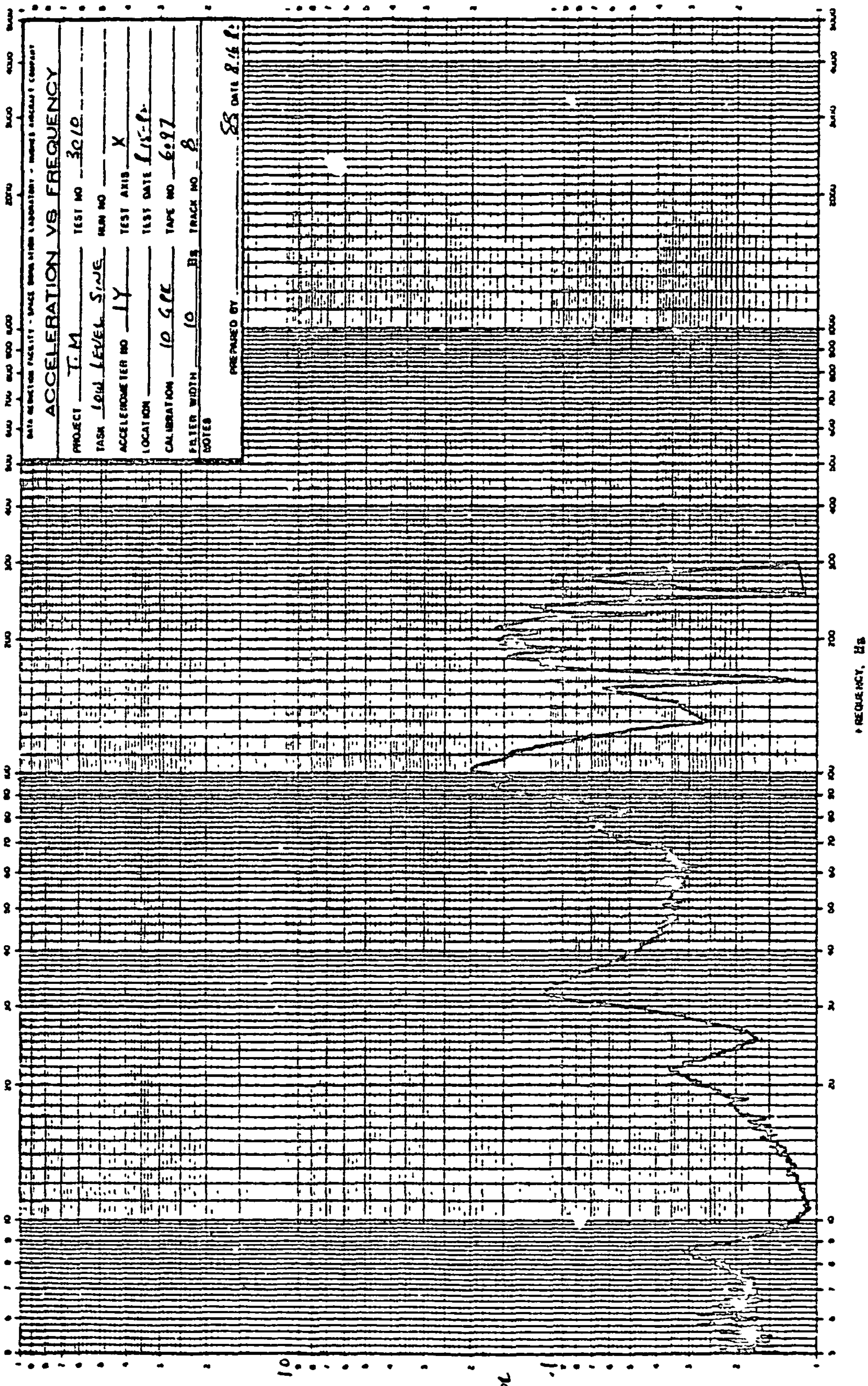

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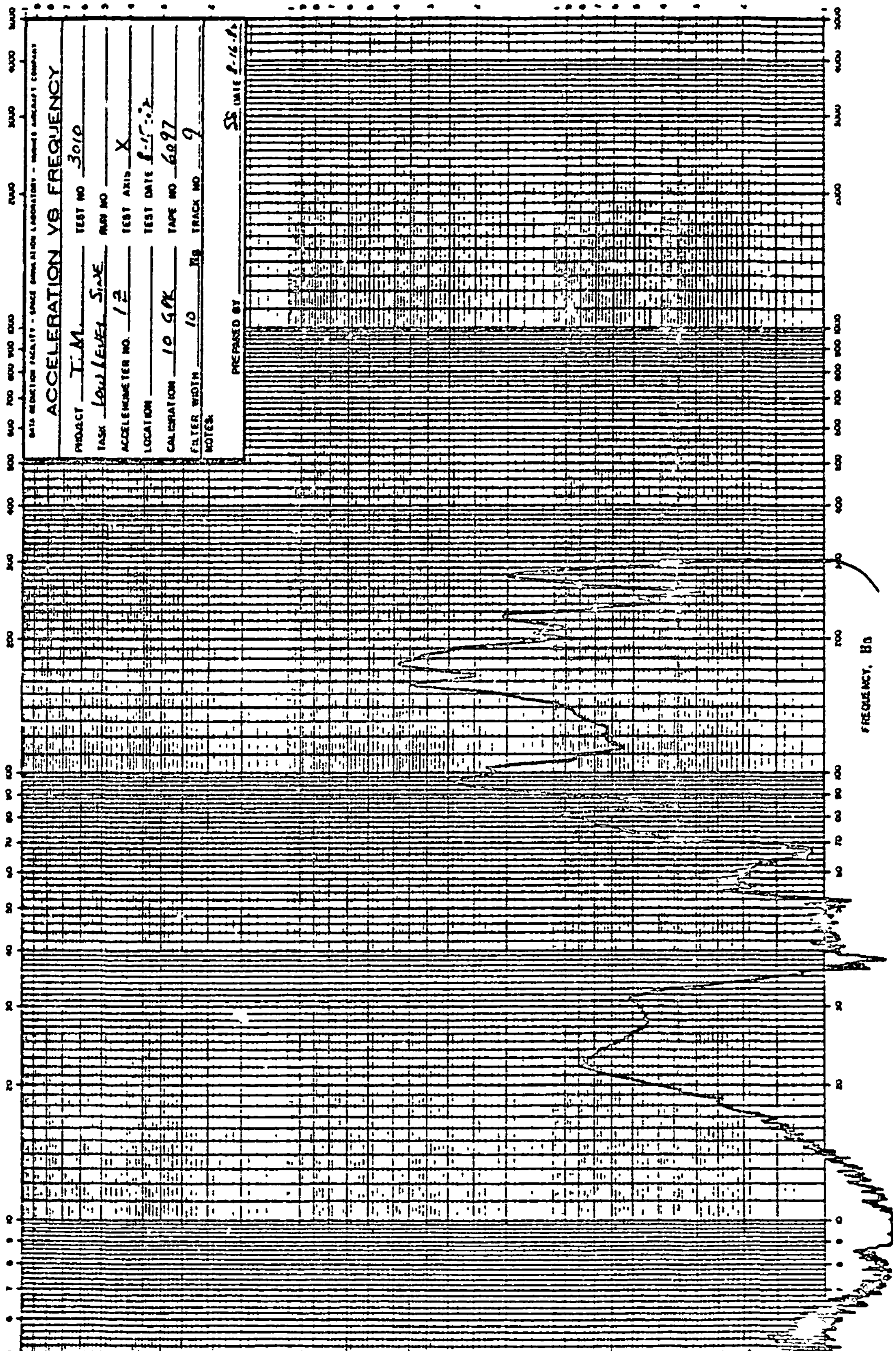

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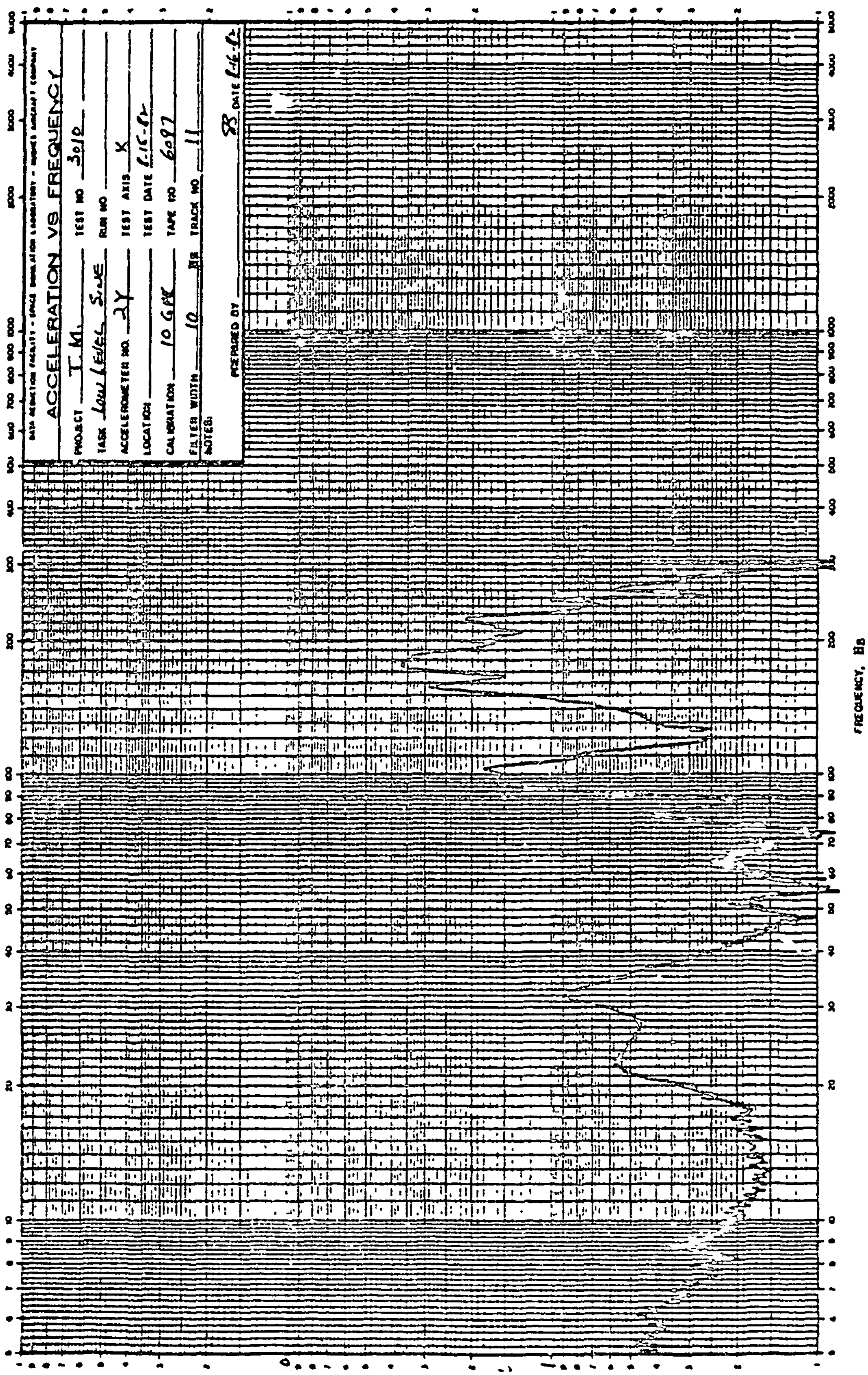

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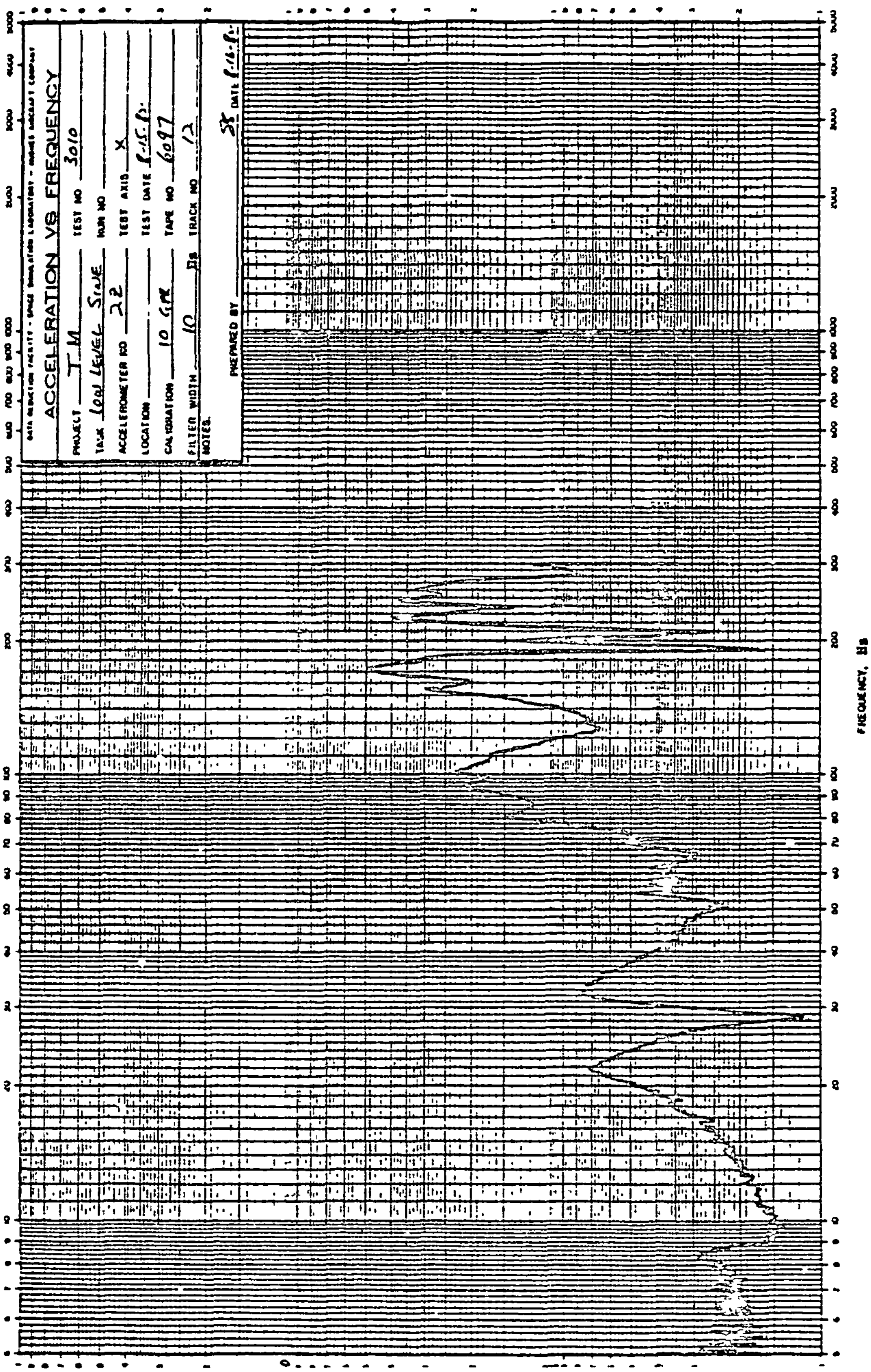

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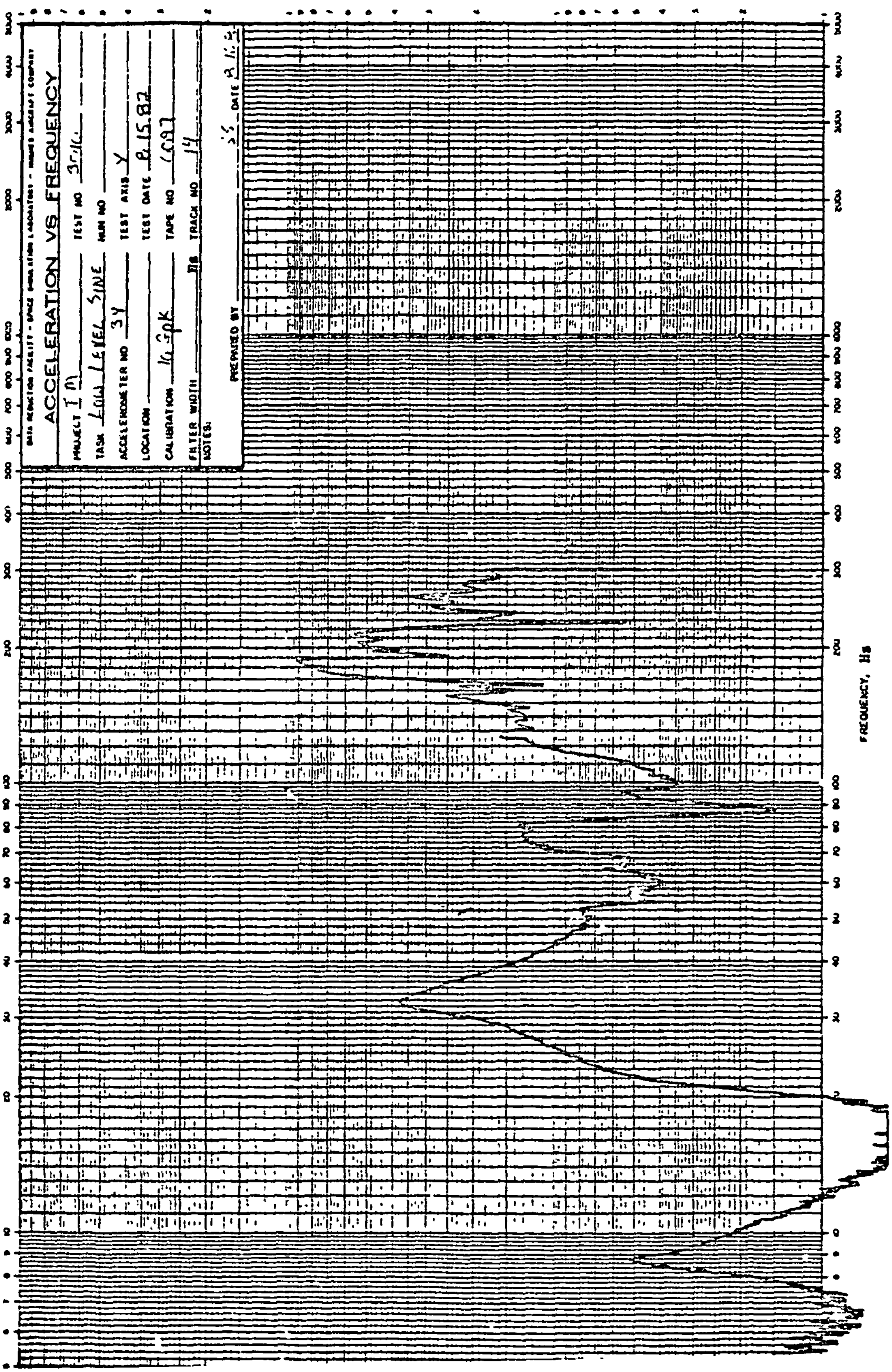

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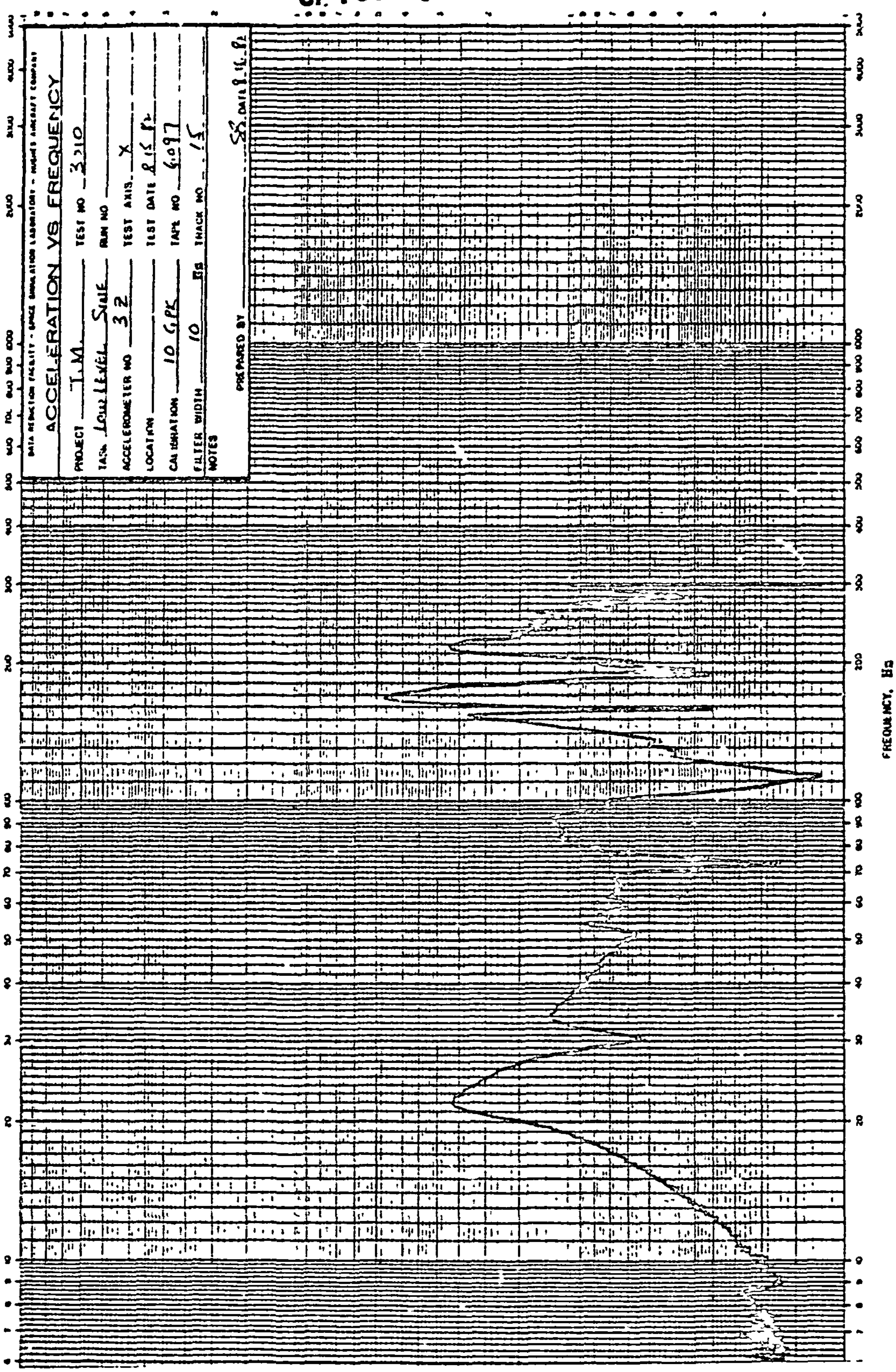

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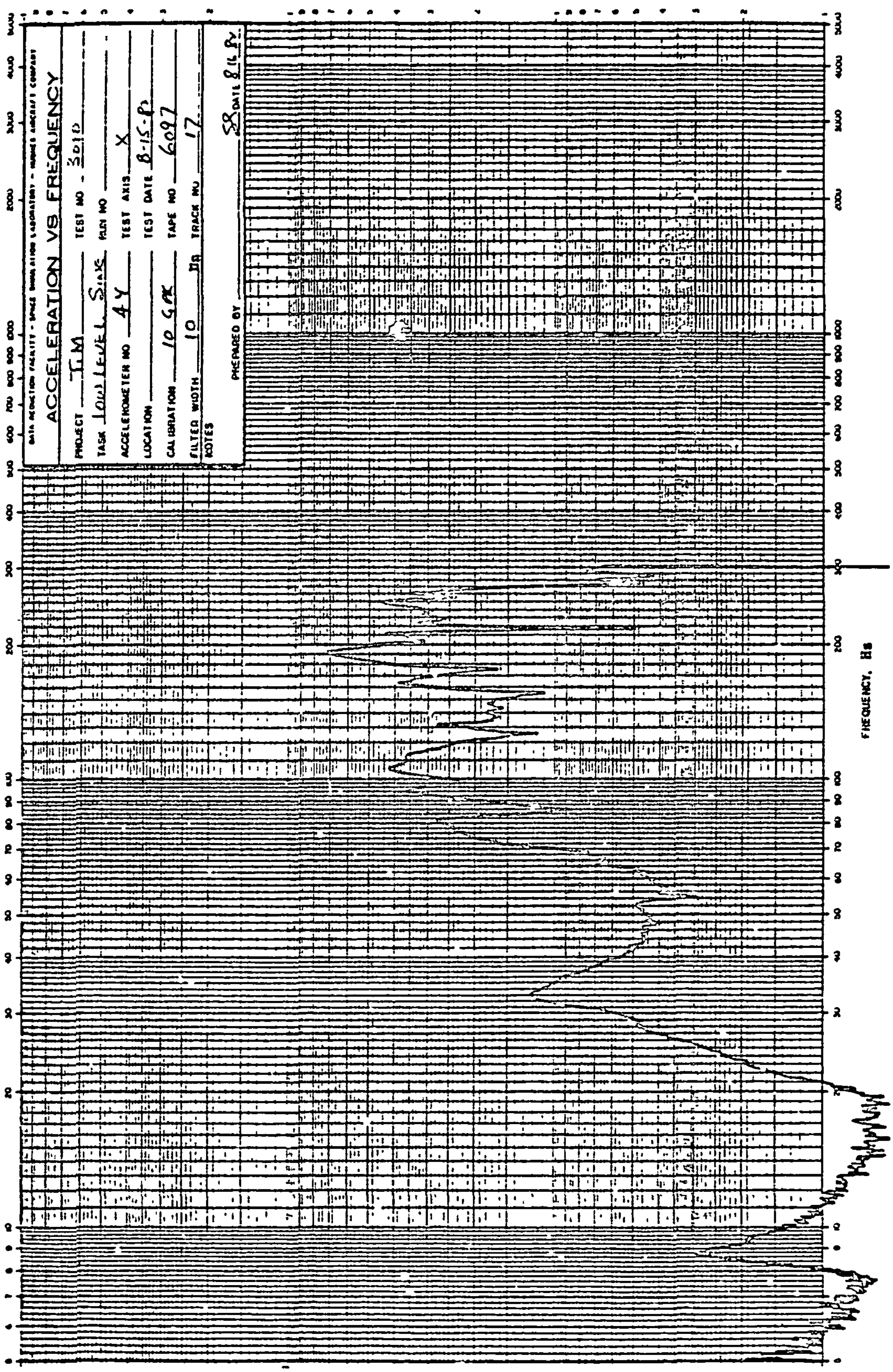

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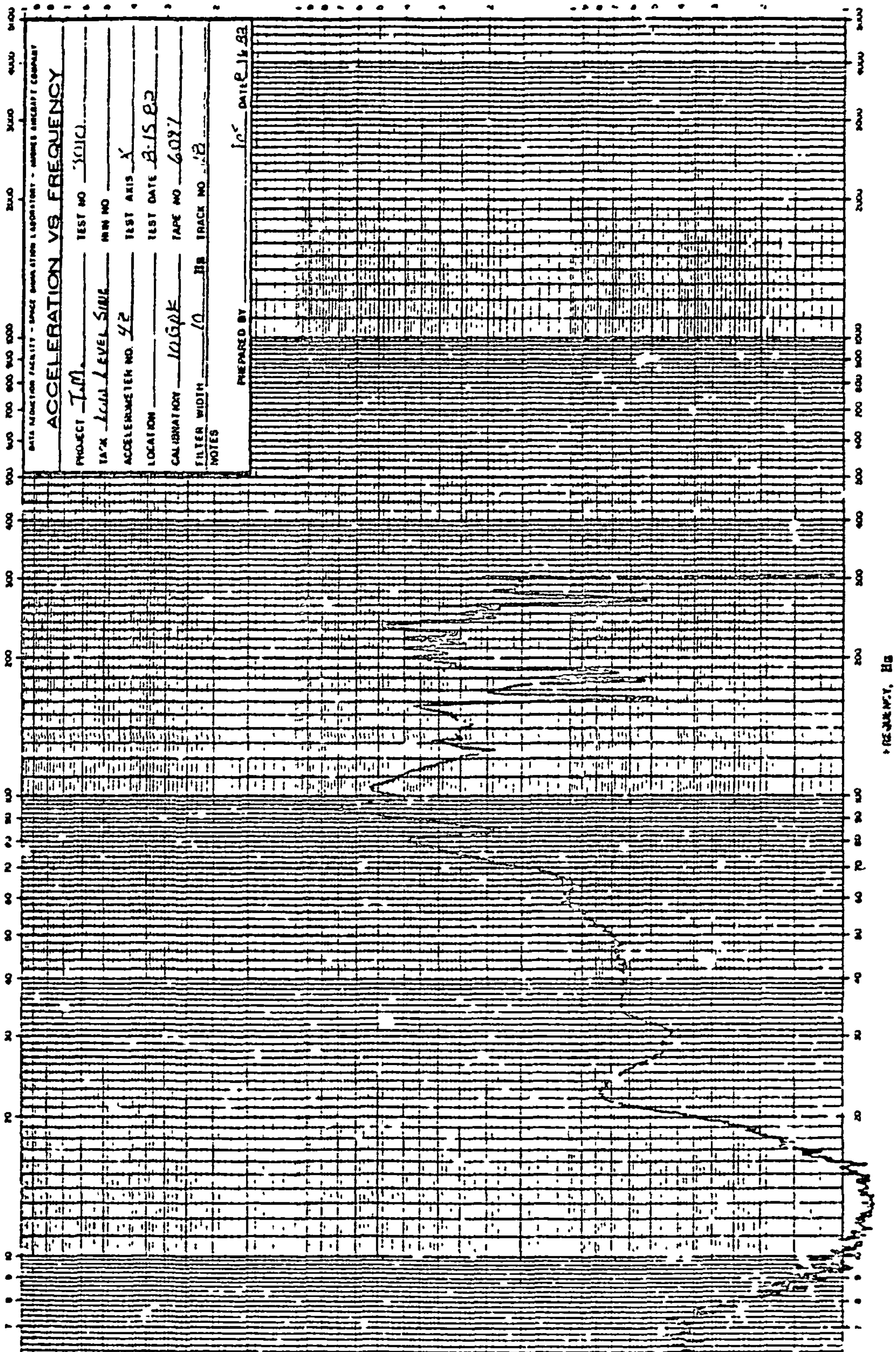

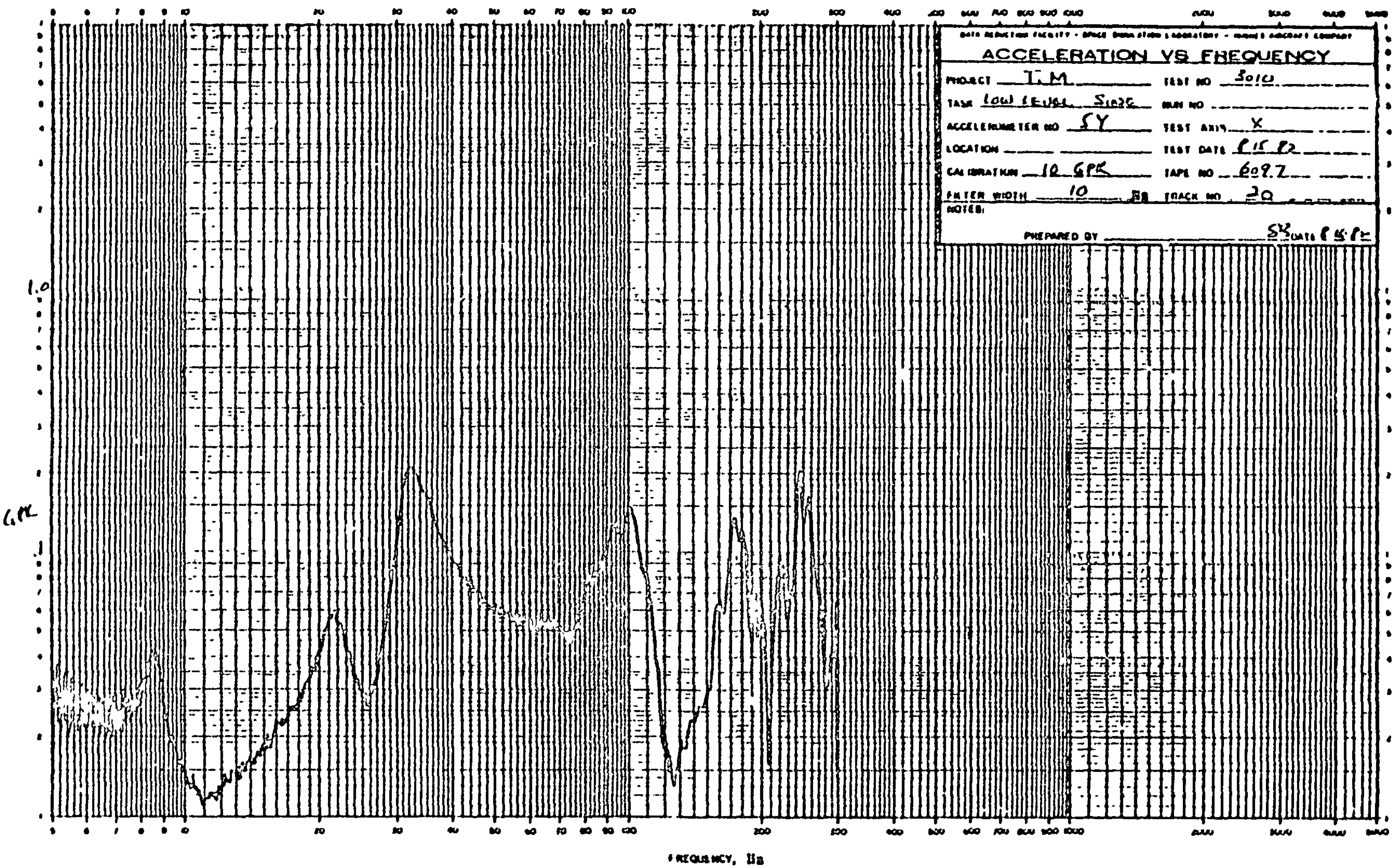

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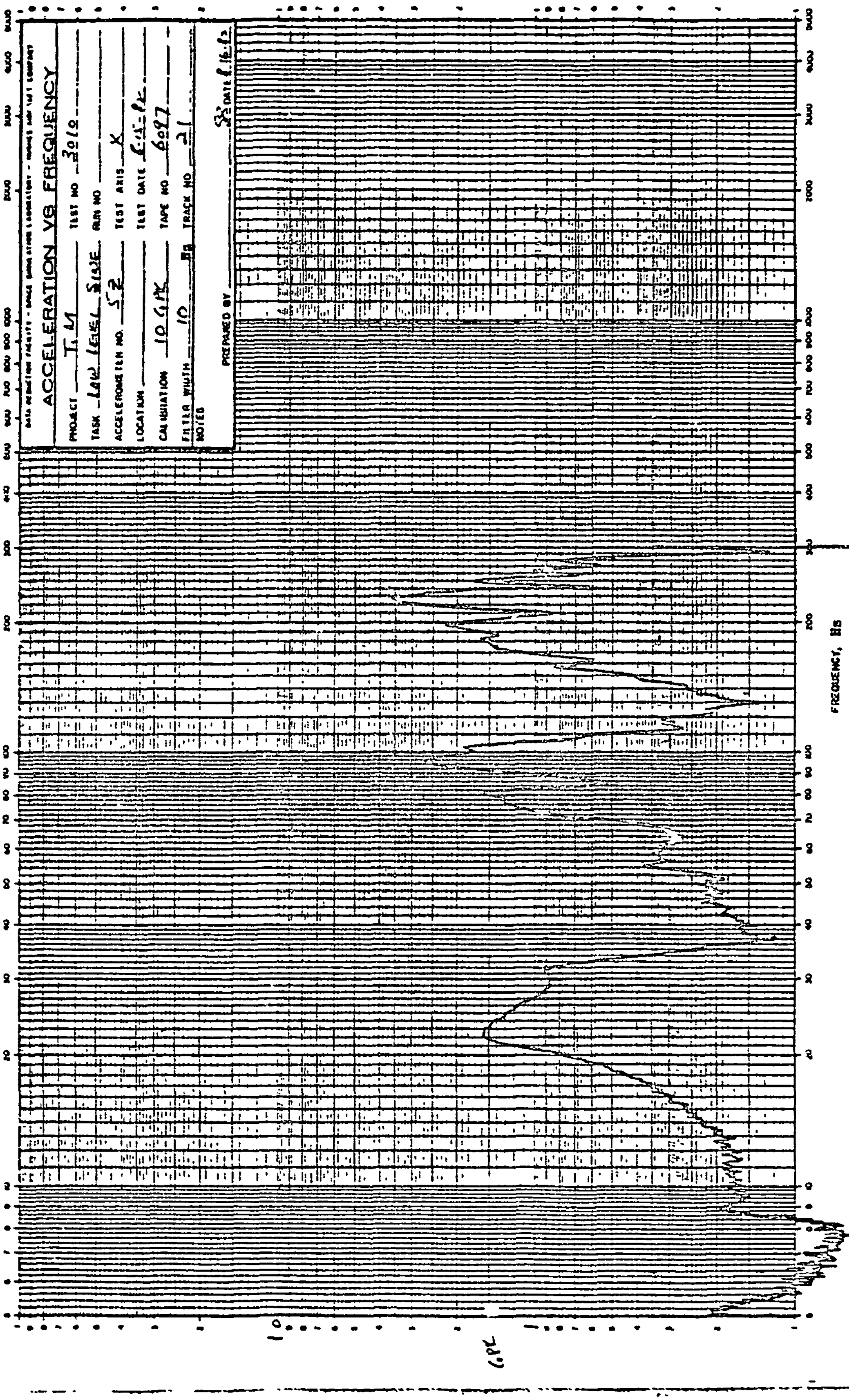

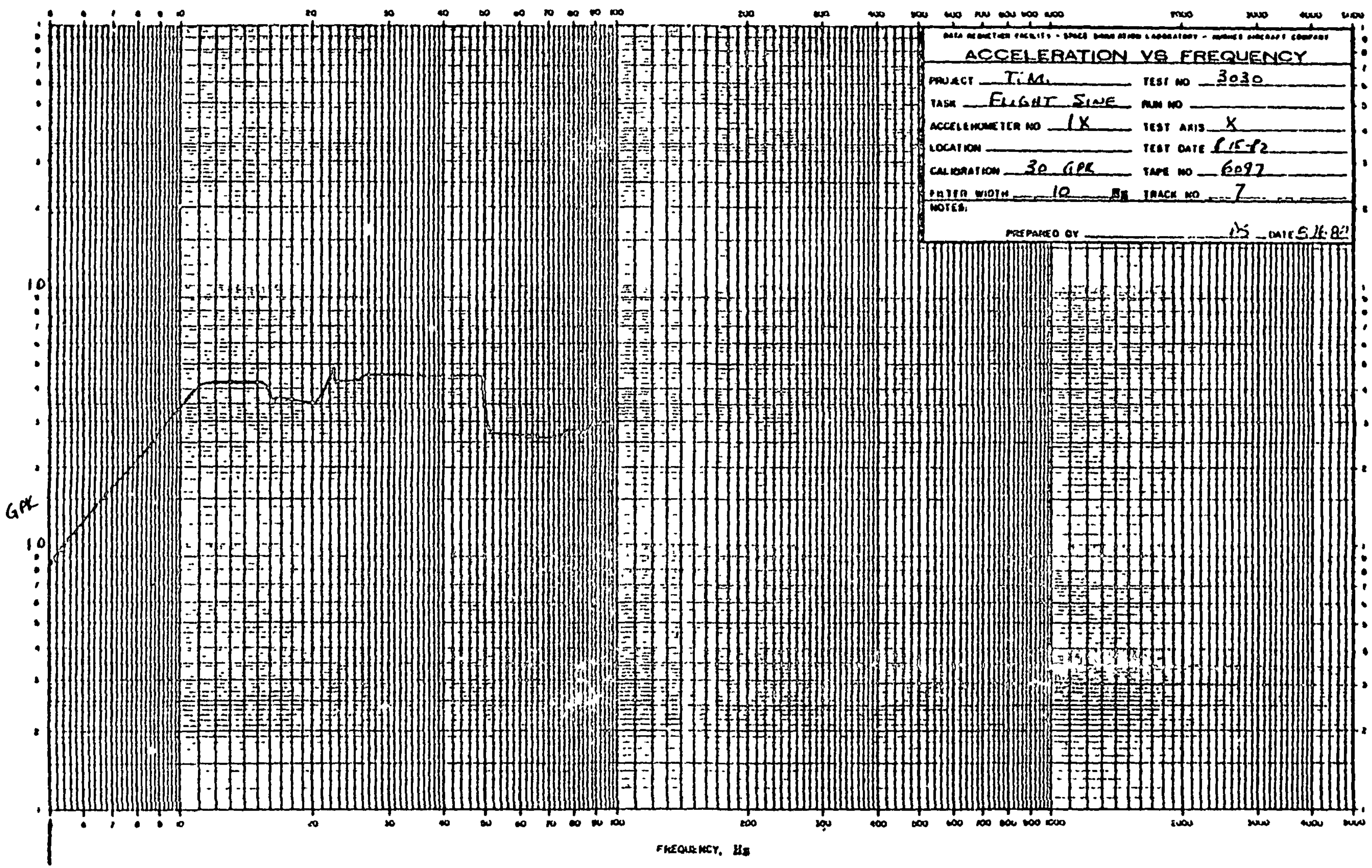

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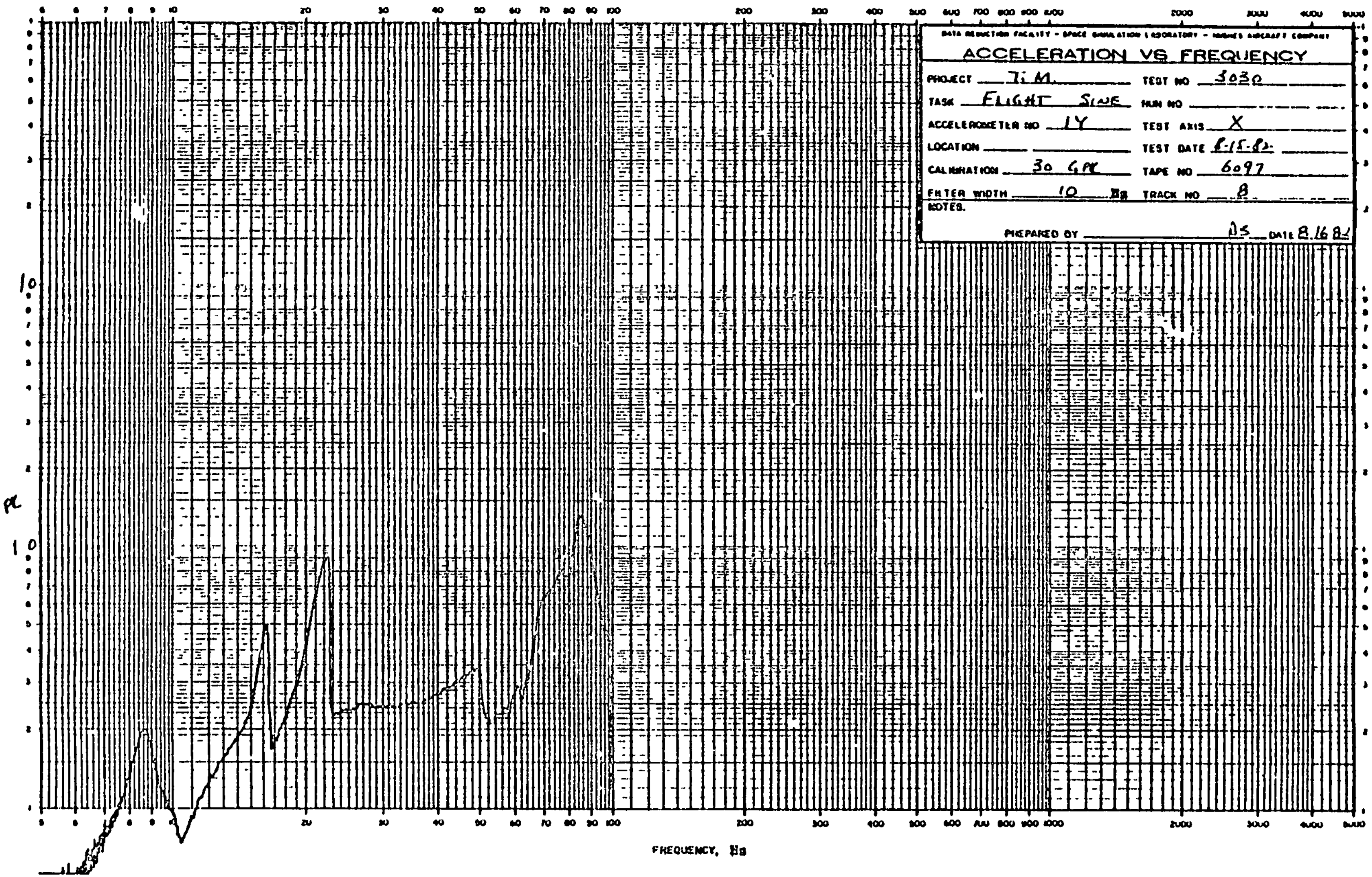

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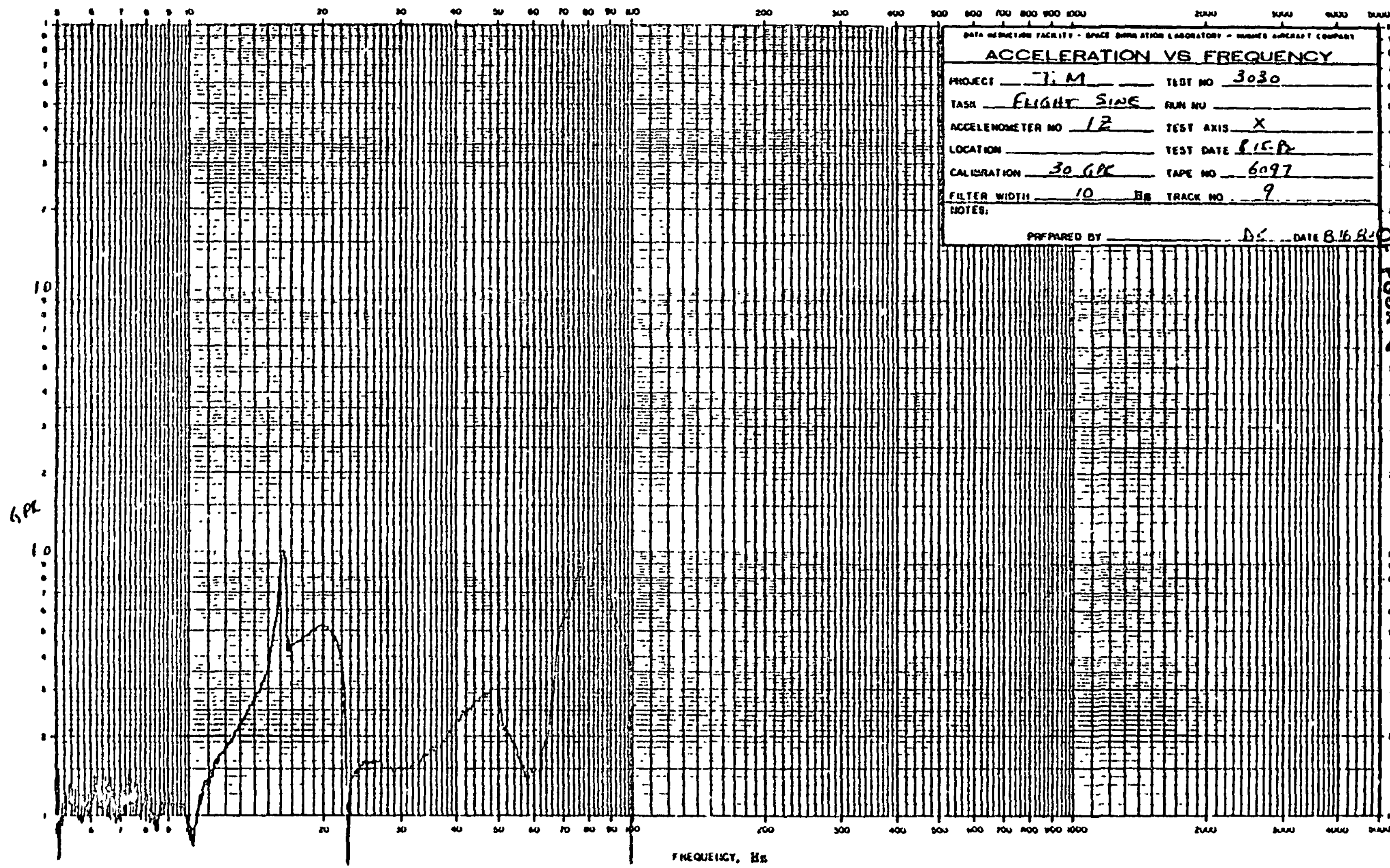

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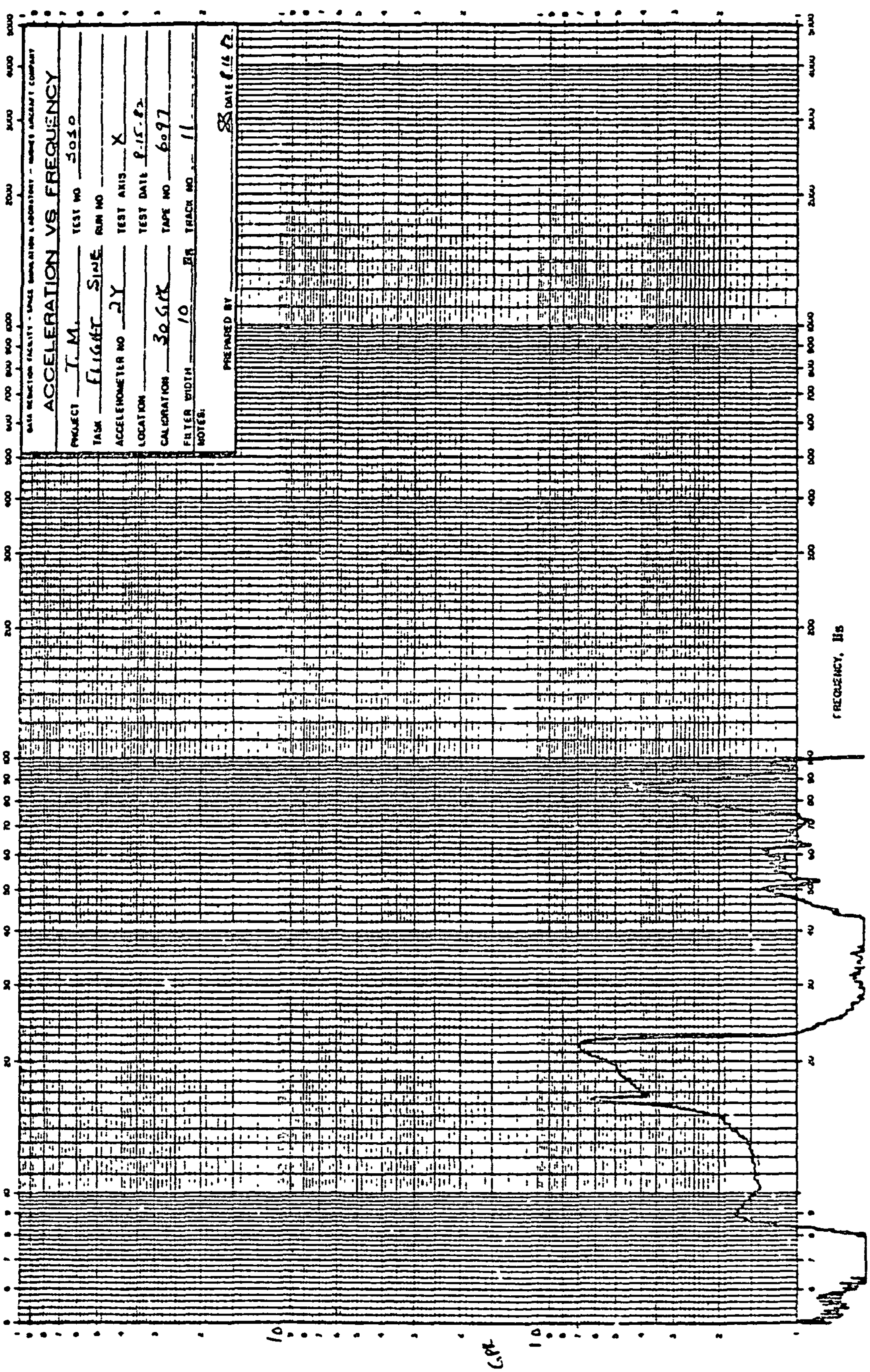

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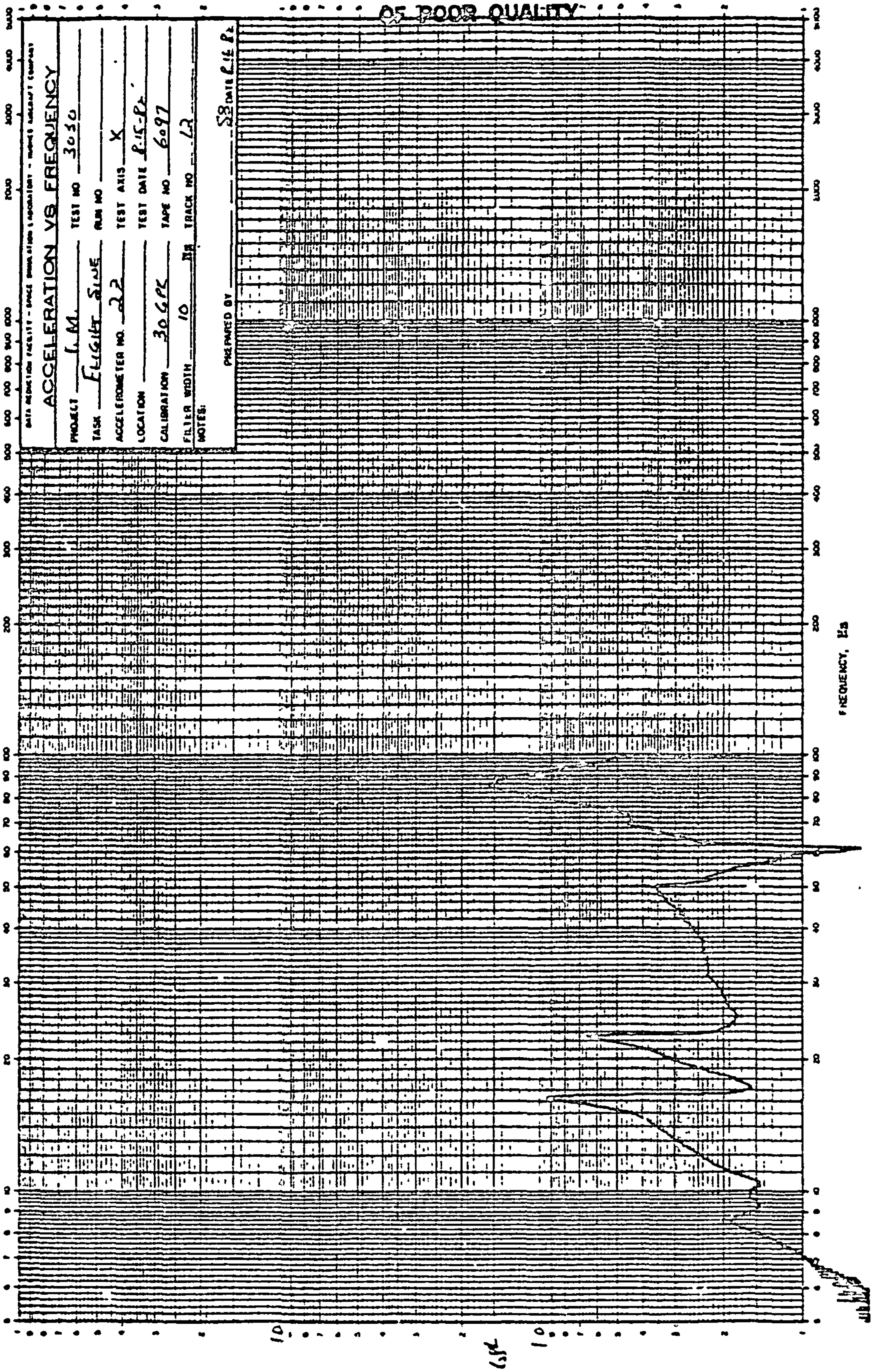

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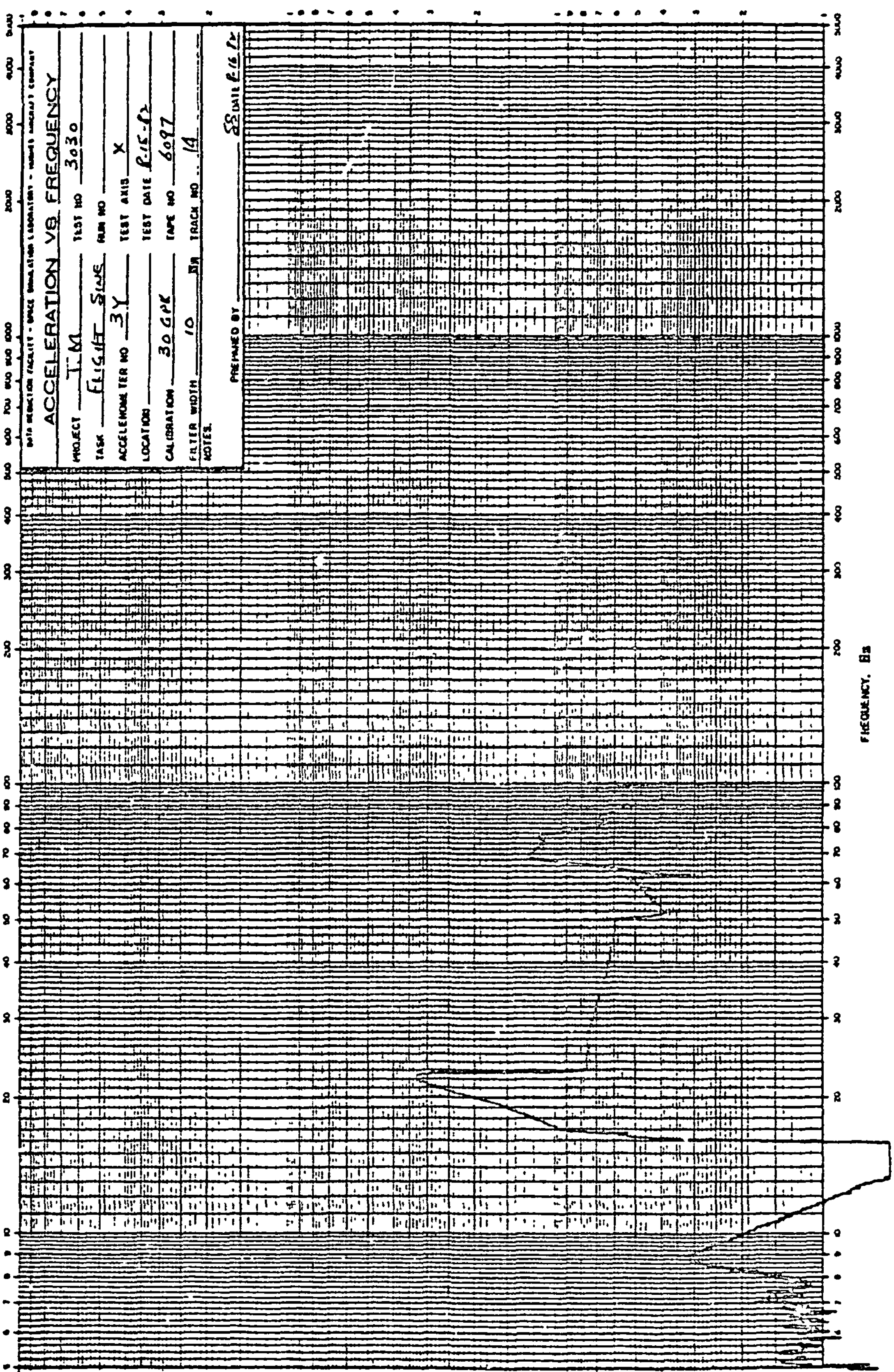

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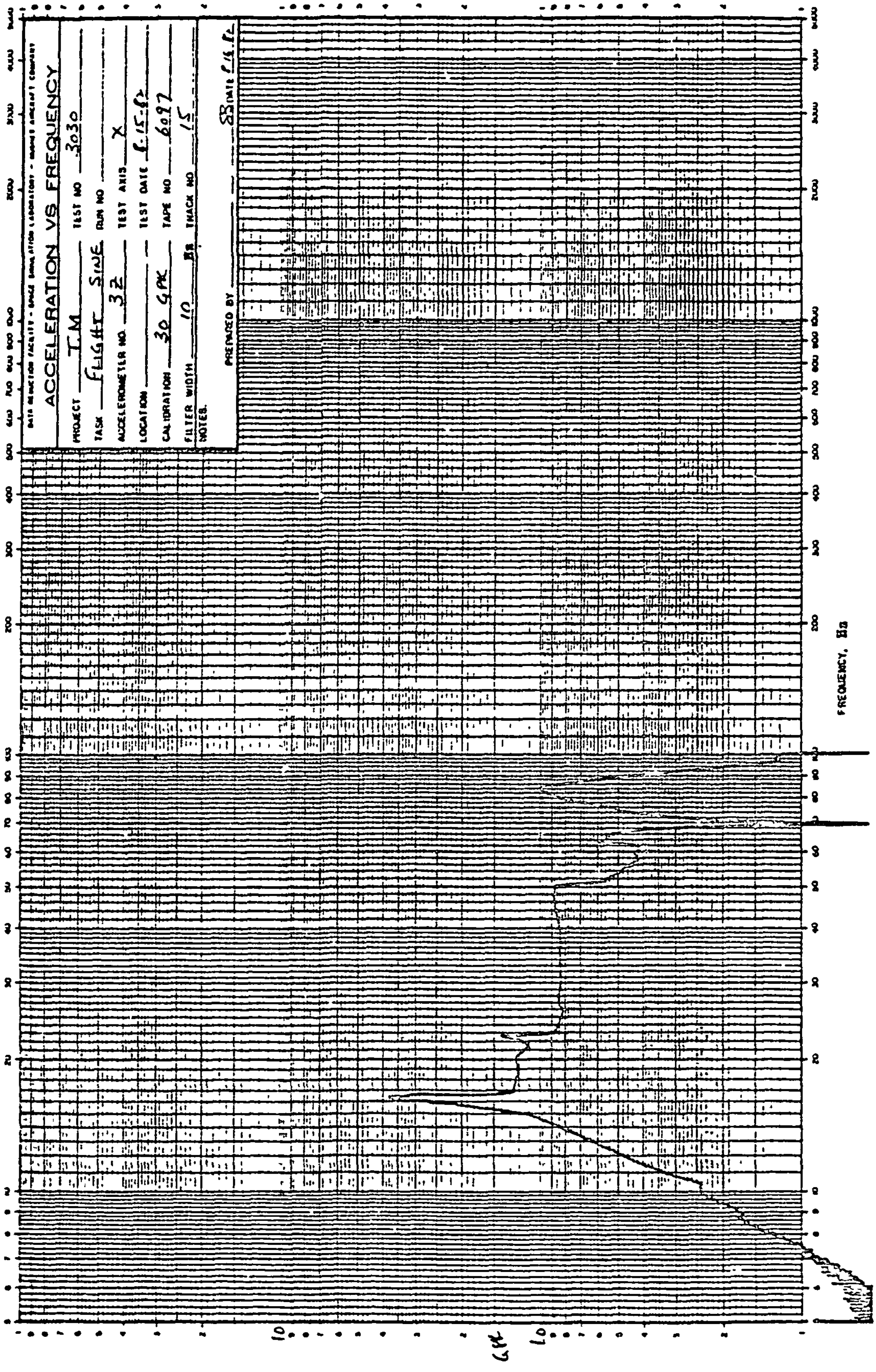

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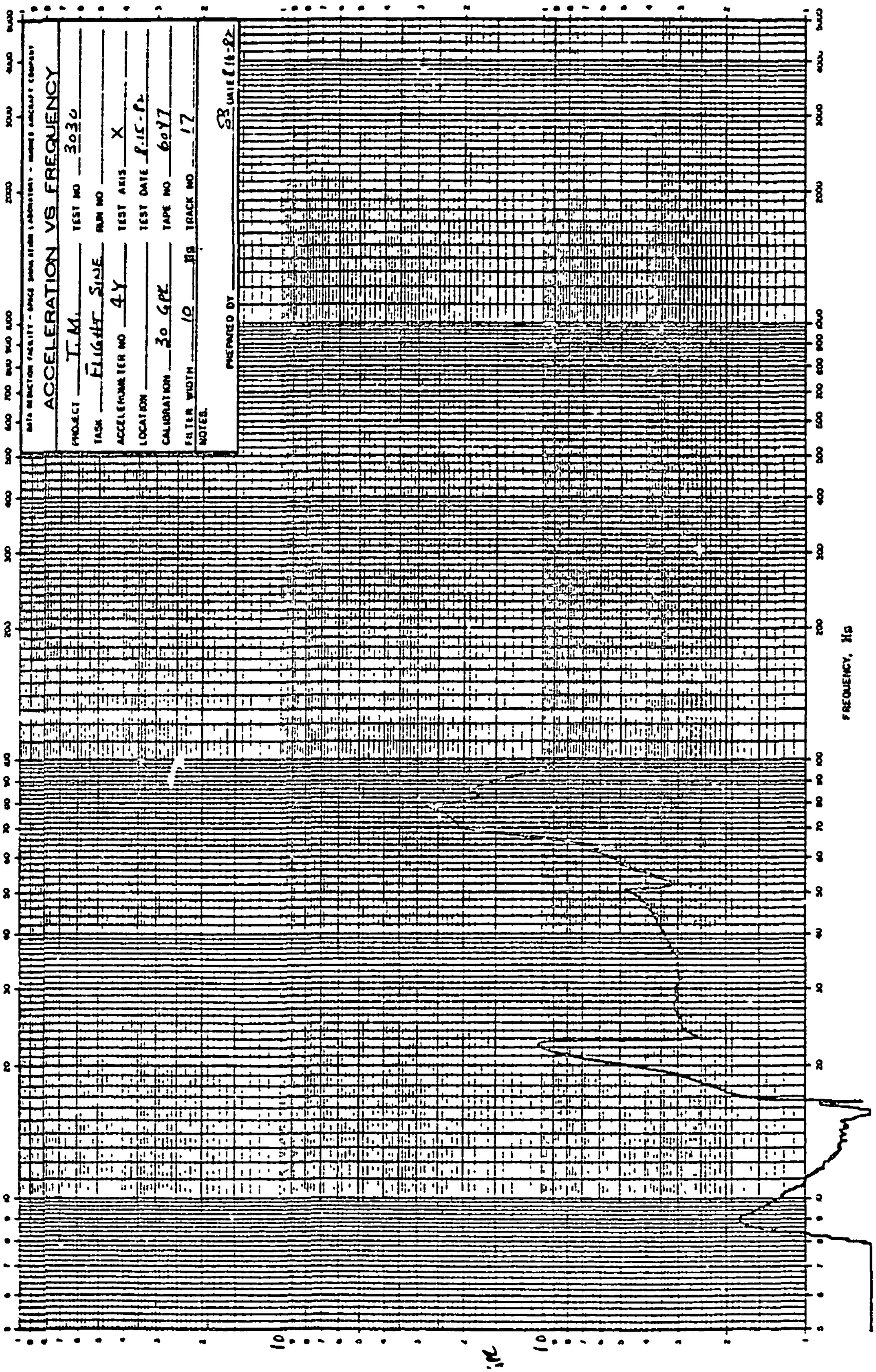

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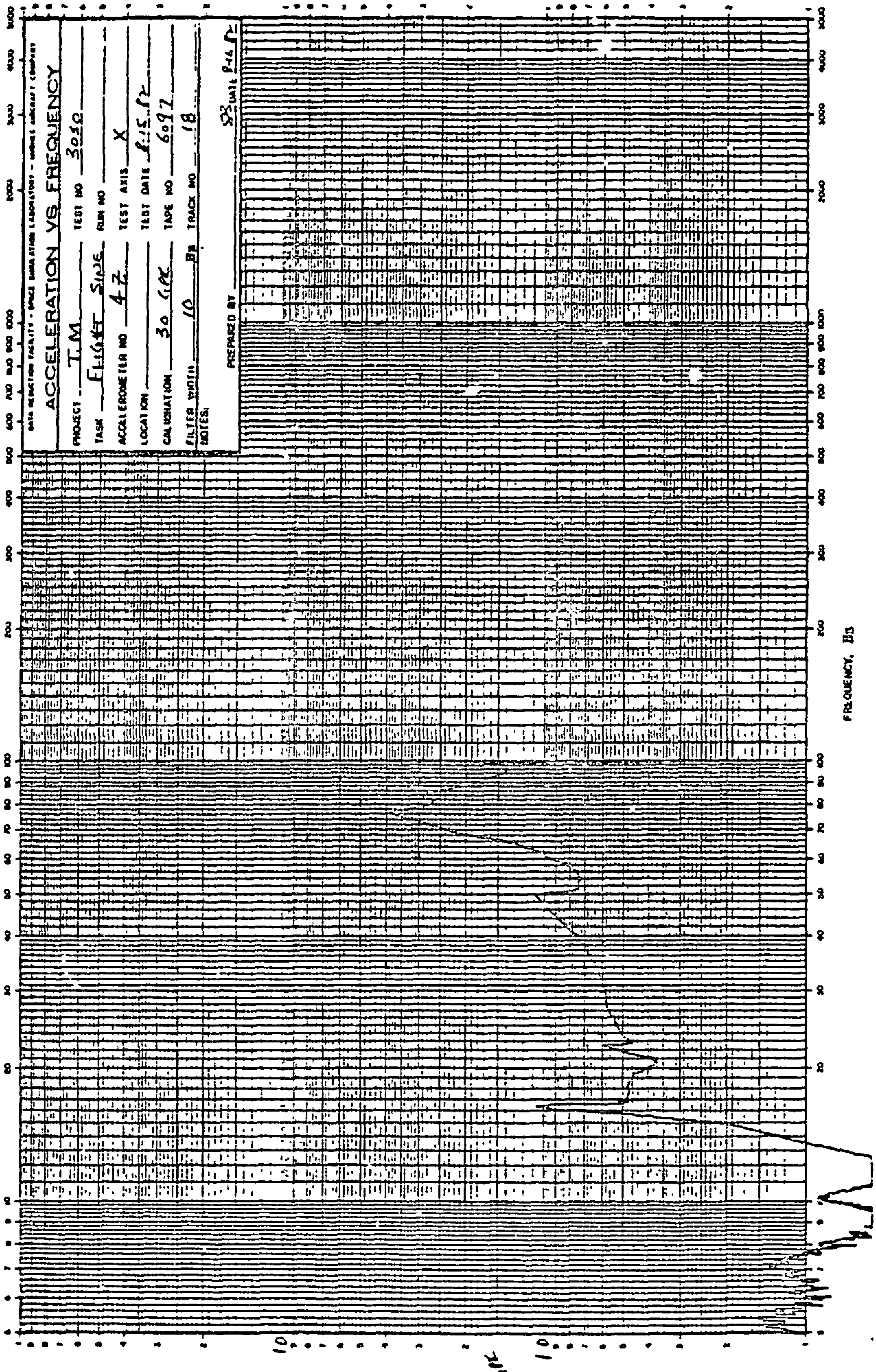

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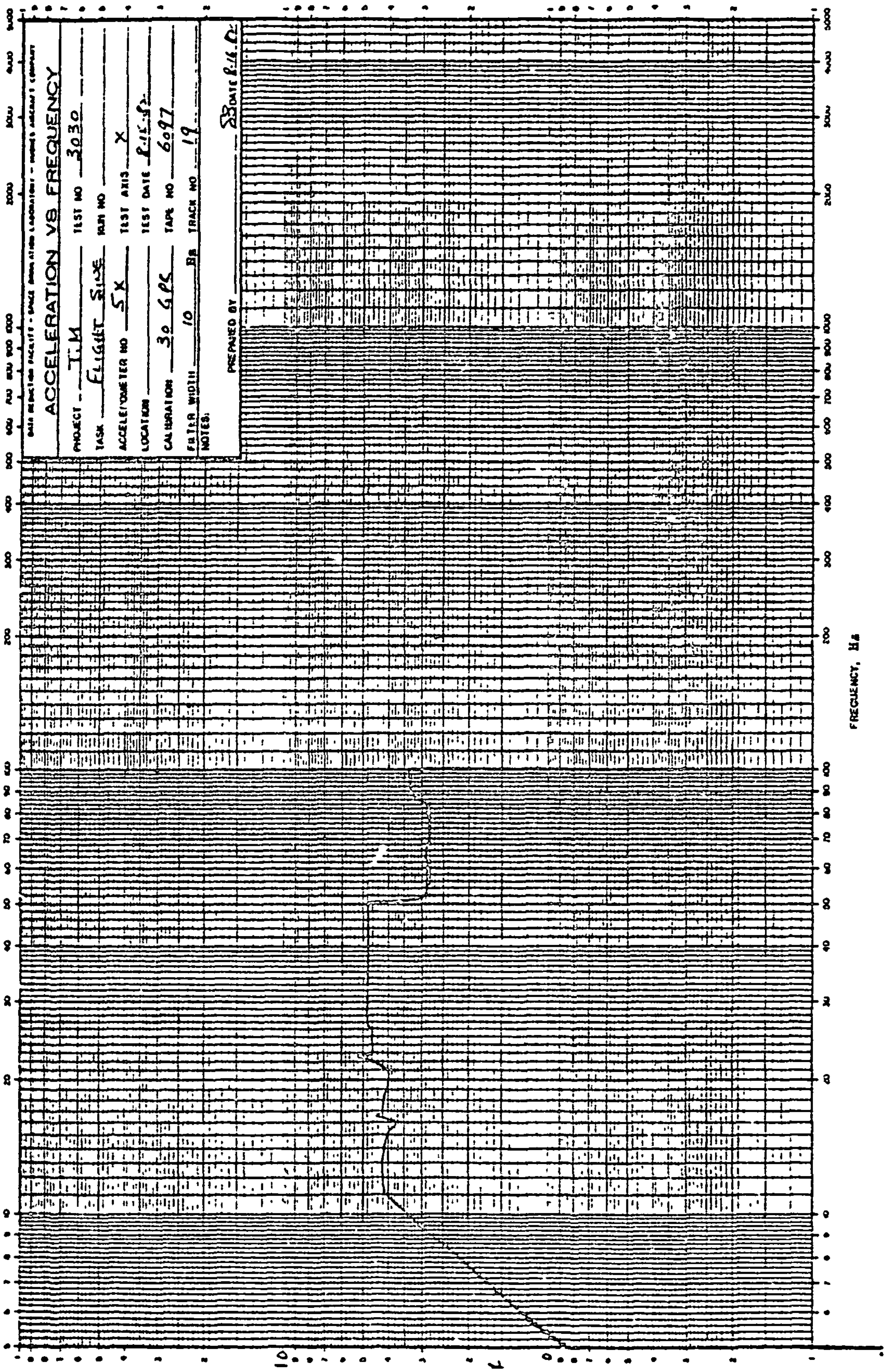

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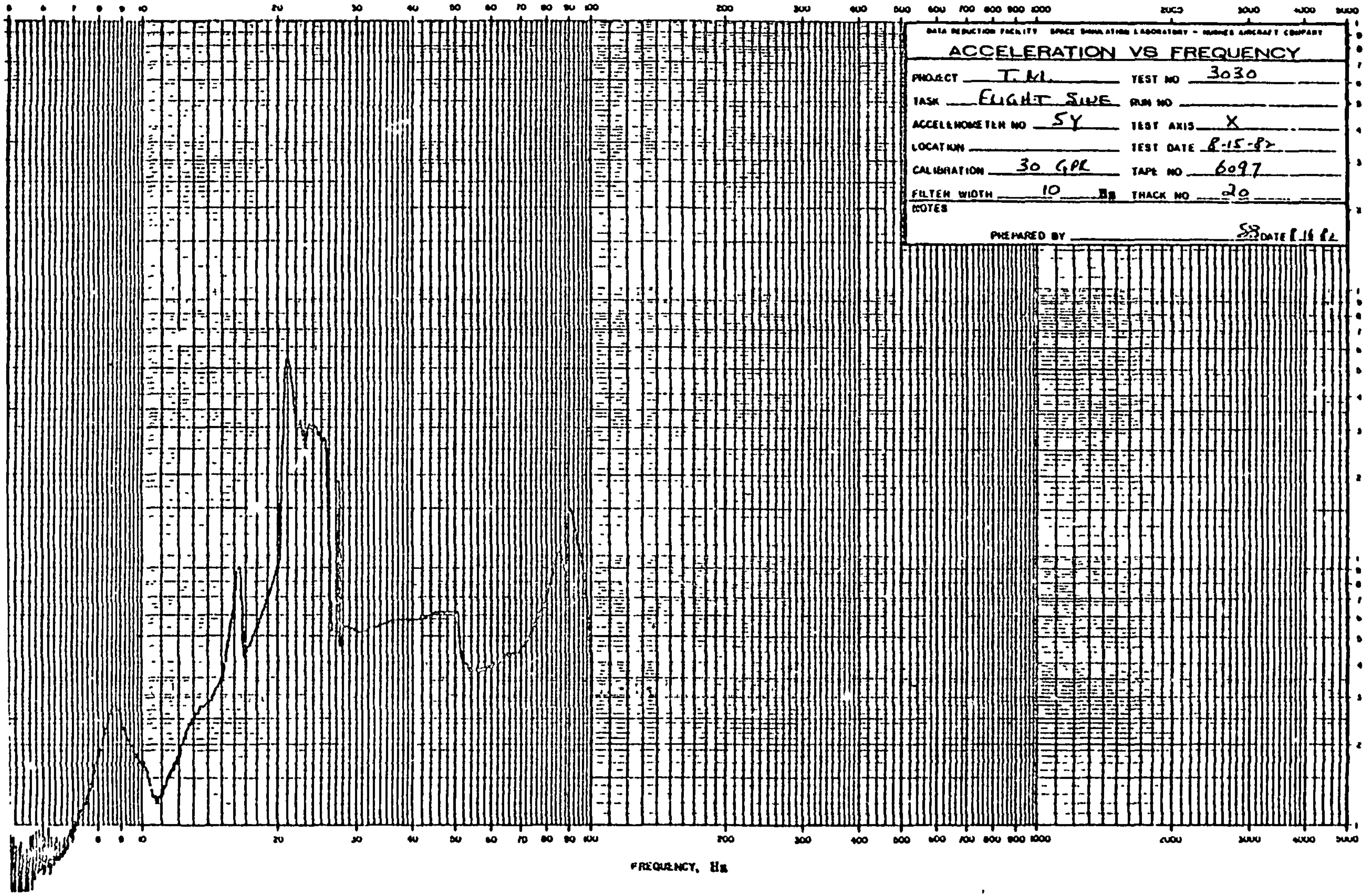

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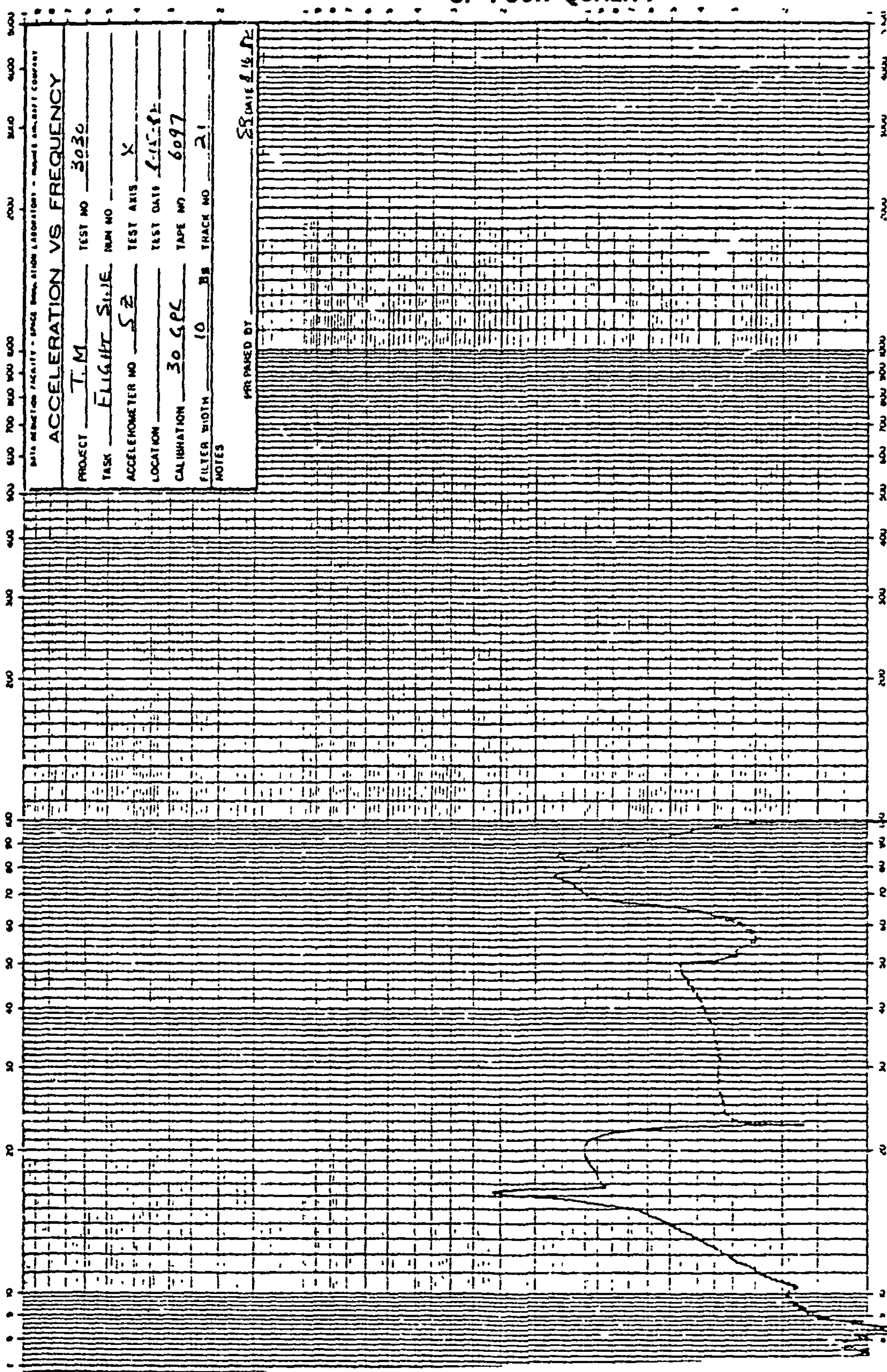

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3.2 INTEGRATION TESTS

The test sequence of the integration tests performed on the Flight Model Thematic Mapper followed that shown in table 3.0-1 of Volume II. Summary results of each test, comparisons to the instrument performance requirements, and comparison to the Protoflight and Flight models are contained in Volume II of this data package. The sections of Volume III contain the following for each test:

(A) A reference list of documents that describe test plans, procedures, or specifications, or related pertinent data necessary for a thorough understanding of the test. Reference documents are included in the appendix to this set of data (Volume IV), compiled in the order listed herein.

(B) A copy of the test result summary.

3.2.1 IA01 TEST

Band 1-4 Focus, Interconnect Verification

Test Summary: HS236-7990 E.M. Kelly

Test Specification: TP32015-501 Prime Focal Plane Coarse and Fine Focus

Reference Documentation: HS236-7876; Flight Model, Test IA01: Coarse Focus/MTF/Shim Requirement, 4 March 1982. P.E. Thurlow

HS236-7992; Effects on MTF for Flight Model Systems Due to Variation of Telescope Moisture Content, 17 May 1982. J.B. Young

SANTA BARBARA RESEARCH CENTER
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INTERNAL MEMORANDUM

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TO: Distribution
(See attached List)

CC:

DATE: 12 May 1982

REF: HS236-7990
SED-98

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SUBJECT: IA01R TEST RESULT SUMMARY,
T.M. Flight Model

FROM E. M. Kelly

BLDG. B11 MAIL STA. 101
EXT. 6378

REFERENCES:

1. TP32015-501(G) Prime Focal Plane Coarse and Fine Focus Test Procedure (IA01R).

2. History Tapes #D03006, D03007 & D03009 thru D03011.

3. BTCE #2 Event Log for Period 1 March '82 thru 4 March '82, 16 March '82 and 21 March '82 thru 24 March '82.

4. Thurlow, P.E., "Flight Model, Test IA01: Coarse Focus/MTF/ Shim Requirement," HS236-7876, dated 3-4-82.

5. Young, J.B., "Effects on MTF for Flight Model Systems Due to Variation of Telescope Moisture Content," HS236-7992, dated 5-17-82.

6. WAIVER #W145, dated 3-25-82, to delete the post-shimming Fine Focus Test of Band 1, for Flight Model Only.

7. ECR #TP009/01, dated 3-11-82, to optionalize Para.5.2 (Fine Focus Check) and 5.3 (Tilt Check) at the discretion of the Optical Systems Analyst.

8. ECR #BT 379/01, dated 2-15-82, to update Drawing # 3533100-300-1(B) (BTCE INTERCONNECT DIAGRAM, Phase I), to add latest grounding configuration.

9. EO #4206A, dated 3-11-82, to optionalize Para. 5.2 (Fine Focus Check) and 5.3 (Tilt Check).

10. EO #4181A, dated 3-3-82, to reduce Minimum Video Signal from 17.0 to 14.0 V. P-P, and the corresponding Video Count Level from 3891 to 2867.

11. EO #4165A, dated 2-22-82, to add Appendix I (Vignetting Test) to procedure.

SUMMARY

This report contains the key results of IA01R tests performed on 2 March thru 24 March 1982, per Test Procedure TP32015-501(G). The results were used for the determination of:

1. Initial focus position of PFPA.
2. The shim thickness needed between the telescope and aft optics support interface, to move the PFPA to its proper Z axis position (see Ref. 4).
3. Final focus position of the PFPA.

The principal objective is to place the PFPA at best focus, but the PFPA was focused in IA01 without compensating for the moisture effects of the graphite epoxy structure. Moisture analysis determined that the Flight Model Thematic Mapper had a microstrain of 35; therefore the orbital focus change would be:

$$\Delta F = 0.0077 \text{ inch}$$

and the collimator focus change would then be: $\Delta F_{coll} = 0.010$ inch.

From the IA01 MTF focus sensitivity curve, this 0.010 inch focus change would result in an MTF change from 0.485 to 0.46 (a ratio of 0.95); giving a final Flight Model SWR of 0.39 to 0.44 (see Ref. 5).

TEST CONFIGURATION DOCUMENTATION

The test reported herein is an integration-level test performed on the Thematic Mapper (TM) Telescope/Aft Optics Assembly; it is a collimator-type test that uses image quality measurements to guide focal plane positioning.

This test was performed to axially position the Aft Optics Support Assembly relative to the Telescope Assembly, such that the Prime Focal Plane Array (Bands 1 to 4) is placed at the optimum focus of the Telescope.

The test was conducted with the SMA/TM Telescope/Aft Optics Assembly mounted in the TM Main Frame and oriented to align the optical axes of the TM Telescope and the Collimator.

Axial positioning of the Aft Optics Support (with FPA) relative to its interface inside the Telescope Housing was determined by

TEST CONFIGURATION DOCUMENTATION (continued)

calculating the modulation transfer function (MTF) of key detectors in Band 4 during Coarse and Fine Focus Tests. These MTF data were then used to select the correct shim thickness between Telescope and Aft Optics Support Interface. The final shim thickness was then manufactured and installed to maintain proper focus. (The set up, test operations, and shim iteration in flowchart format are shown in Figure 1-1 of the Test Procedure. Figure 1-2 of the Test Procedure schematically illustrates the test arrangement.)

Hardware configuration for this test was in accordance with Procedure TP32015-501(G). The software utilized for data collection and reduction also conformed to that identified in the procedure. Command files, data bases, and video files for all tests were recorded on History Tapes D03006, DC3007 and D03009 thru DO 3011. Command and video file names are coded so that one can readily tell Band and Detector numbers, Focus Position and Cross vs. Along Track Collection Parameters (See TP32015-501(G) Para.3.5.3.5).

TEST RESULTS

This section summarizes the data which resulted from running each part of the IA01R procedure. Table 1 summarizes the series of tests and their test conditions. This table lists each test by name and its section in the IA01R procedure. As noted in the table, "Z-Axis Focus Range" and "Z-Axis Steps" refer to motion of the MTF wheel from its "Home" position at the Focal Plane of the Collimator. The "Collimator to TM Alignment" column lists the location in the TM Prime Focal Plane with which the collimator axis is aligned during each test. This alignment was adjusted for each test by rotating the TM on its Azimuth Table.

Appendix A contains a copy of the Oscilloscope Photos placed in the Data Master; the tabulated MTF values may be compared with the SWR values which may be obtained from these scope traces. Tables 2 through 10 summarize the results of the remaining test sequences. Figure 1 contains plots which are derived from this last group of tables. Figure 2 is a copy of the page in the Data Master where the new shim thickness was computed.

DISCUSSION AND CONCLUSIONS

PRE-SHIM

On 2 March 1982 the initial IA01R Coarse Focus (IA1 CFF.DSL)

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PRE-SHIM (continued)

and Fine Focus (IA1FFF.DSL) tests were run. Coarse Focus results showed that the cross track and along track runs were about 0.010" apart, with cross track being within 0.004" of "HOME;" therefore a shift in Z-axis "HOME" position was not required for Fine Focus. Fine Focus results showed a -0.006" shift in peak MTF location, consequently we repeated the Fine Focus runs, although test equipment breakdown produced only cross track data.

In repeating the IA01R Fine Focus runs, an Aerotech Stage Controller became defective; it could not be computer commanded to move in the Z-axis. After unsuccessfully replacing the Aerotech Stage Controller we returned to the original controller, manually stepping the Z-axis stage at the controller while monitoring the Fine Focus (IA1FFF.DSL) Command Files. Cross track run results were nearly identical to that of the first Fine Focus runs.

On 3 March 1982 the Coarse Focus (IA1CFF.DSL) tests were repeated twice, with the Z-axis stage being manually moved--through the stage controller. Optics Systems Analyst plotted both Coarse Focus runs, with results showing "excellent agreement." From evaluation of coarse Focus and Fine Focus plotted data (of 2nd and 3rd March), Optics recommended a shim thickness reduction of 0.0618" from the trial shim thickness of 0.250", to a 0.1882" thickness. Shim to be used will be 0.188" ($\pm$ 0.001"), (see reference #4).

Specific Pre-shim test results are shown in Tables 2 through 6.

POST-SHIM

Initially we performed a Coarse Focus cross track run on 16 March 1982, to verify shim thickness. Results showed peak MTF to be within 2-3 mils of Collimator Focal Plane, verifying shim thickness and setting a good basis for proceeding to formal Fine Focus tests of Bands 1 through 4.

On 21 March 1982 we encountered computer problems in trying to run the formal Fine Focus tests. After computer and disc servicemen repaired same, we encountered video problems on Band 1. Problem was in DC restore; to correct same we moved MTF wheel pick-off point about 1°(ccw) earlier. Meanwhile we tested Band 2 Fine Focus (IA1B2F.DSL) in cross track modes with only partial data collects (6 good ones out of 9). After more test equipment troubleshooting, we resumed formal testing on 22 March 1982, testing Band 2 Fine Focus (IA1B2F.DSL). Band 2 results showed peak MTF at collimator focus of:

Cross Track = +0.007"

Along Track = +0.006"

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POST-SHIM (continued)

On 23 March 1982 we ran Band 3 Fine Focus (IA1B3F.DSL). We repeated the along track run because the first along track run failed during data reduction--producing no printed data. Band 3 results showed peak MTF at collimator focus of:

Cross Track = +0.007"

Along Track + -0.001"

Then we ran Band 4 Fine Focus (IA1B4F.DSL). Band 4 results showed peak MTF at collimator focus of:

Cross Track = +0.004"

Along Track = -0.006"

Specific Post-shim test results are shown in Tables 7 through 10.

E. M. Kelly

E. M. Kelly
Test Director

P. Thurlow

P. E. Thurlow
Optics Analyst/Systems
Engineer

Approval by:

G. S. Plews, Manager
Systems Integration & Test

Release Approval:

J. L. Engel, Manager
Systems Engineering Dept.

EMK:pg

Attachments: 12 + Appendix A (Pgs.1-6)
Distribution for IA01

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Attachment 1

HS236-7990

12 May 1982

TABLE 1

SUMMARY OF IA01 TESTS

TP PARA.	TEST NAME	DATE 1982	B/D USED	Z-AXIS STEPS	Z-AXIS FOCUS RANGE	COLL TO TM ALIGNMENT
PRE-SHIM:						
5.1.6	"SCOPE	3/1	4/9	-	± 0.020"	ON-AXIS
	PHOTOS"	3/1	4/9	-	± 0.040"	ON-AXIS
5.1.7	CF(CT,AT)	3/2	4/9	.010"	± 0.040"	ON-AXIS
5.2	FF(CT,AT)	3/2	4/9	.005"	± 0.020"	BAND 4 ODD
	FF(CT)	3/2	4/9	.005"	± 0.020"	BAND 4 ODD
5.1.7	CF(CT,AT)	3/3	4/9	.010"	± 0.040"	BAND 4 ODD
	CF(CT,AT)	3/3	4/9	.010"	± 0.040"	BAND 4 ODD
POST-SHIM:						
5.1.7	CF(CT)	3/16	4/9	.010"	± 0.040"	BAND 4 ODD
5.6	FF(CT,AT)	3/22	2/9	.005"	± 0.020"	BAND 2 ODD
5.7	FF(CT,AT)	3/23	3/9	.005"	± 0.020"	BAND 3 ODD
5.8	FF(CT,AT)	3/23	4/9	.005"	± 0.020"	BAND 4 ODD

NOTES:

(1) Above tests indicate runs with complete valid data collects.

(2) When Band 1 video became available, after correcting DC restore problem, the computer became inoperative, so Para.5.5 (Band 1 Fine Focus Test) was waived by WAIVER #W145, for Flight Model only, so that Flight Thematic Mapper integration could proceed.

(3) CF = Coarse Focus Test   CT = Cross Track Test Mode
FF = Fine Focus Test   AT = Along Track Test Mode

Attachment 2

HS236-7990 12 May 1982

TABLE 2

FIRST PRE-SHIM COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.040"	.2409	.1387
+.030"	.3254	.2504
+.020"	.4114	.3272
+.010"	.4621	.4044
.000"	.4949	.4603
-.010"	.4849	.4839
-.020"	.4525	.4813
-.030"	.3739	.4515
-.040"	.3020	.3854

DATA COLLECTION Date/Time: 2 March 1982/
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HS236-7990

Attachment 3
12 May 1982

TABLE 3

FIRST PRE-SHIM FINE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.3649	.2999
+.015"	.3973	.3320
+.010"	.4246	.3604
+.005"	.4485	.4021
.000"	.4691	.4349
-.005"	.4827	.4564
-.010"	.4816	.4706
-.015"	.4765	.4848
-.020"	.4691	.4887

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HS236-7990

Attachment 4

12 May 1982

TABLE 4

SECOND PRE-SHIM FINE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.3397	-
+.015"	.3822	-
+.010"	.4077	-
+.005"	.4353	-
.000"	.4572	-
-.005"	.4746	-
-.010"	.4792	-
-.015"	.4784	-
-.020"	.4697	-

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Attachment 5

HS236-7990

12 May 1982

TABLE 5

SECOND PRE-SHIM COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.040"	.3611	.4868
+.030"	.4265	.4990
+.020"	.4705	.4764
+.010"	.4798	.4339
.000"	.4592	.3613
-.010"	.4056	.2740
-.020"	.3324	.1876
-.030"	.2458	.8208
-.040"	.1626	.1587

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19:30 & 20:10

NOTE: Manual runs were made in reverse direction from normal: -0.040" to +0.040," with no apparent problems.

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Attachment 6

HS236-7990

12 May 1982

TABLE 6

FINAL PRE-SHIM COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.1685	.6738
+.015"	.2556	.1562
+.010"	.3397	.2493
+.005"	.4144	.3272
.000"	.4621	.4143
-.005"	.4851	.4663
-.010"	.4753	.4936
-.015"	.4317	.4882
-.020"	.3607	.4628

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Attachment 7

12 May 1982

TABLE 7

POST-SHIM COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.040"	.3234	-
+.030"	.3903	-
+.020"	.4327	-
+.010"	.4514	-
.000"	.4408	-
-.010"	.4023	-
-.020"	.3305	-
-.030"	.2513	-
-.040"	.1596	-

DATA COLLECTION Data/Time: 16 March 1982/
18:00

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Attachment 8

HS236-7990

12 May 1982

TABLE 8

SECOND POST-SHIM BAND 2 FINE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 2 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.4428	.4004
+.015"	.4455	.4225
+.010"	.4510	.4296
+.005"	.4415	.4493
.000"	.4315	.4477
-.005"	.4163	.4505
-.010"	.3870	.4419
-.015"	.3427	.4246
-.020"	.3073	.4032

DATA COLLECTION Date/Time: 22 March 1982/
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NOTE: First Post-shim Band 2 Fine Focus Test was attempted on 21 March 1982 with only partial data collects due to test equipment problems.

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Attachment 9

12 May 1982

TABLE 9

POST-SHIM BAND 3 FINE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 3 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.4138	.4212
+.015"	.4275	.4363
+.010"	.4428	.4424
+.005"	.4461	.4538
.000"	.4486	.4419
-.005"	.4377	.4307
-.010"	.4123	.4141
-.015"	.4038	.3978
-.020"	.3846	.3569

DATA COLLECTION Date/Time: 23 March 1982/
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Attachment 10

HS236-7990

12 May 1982

TABLE 10

POST-SHIM BAND 4 FINE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z POSITION	CT MTF	AT MTF
+.020"	.3571	.4000
+.015"	.3925	.4220
+.010"	.4231	.4421
+.005"	.4370	.4560
.000"	.4536	.4569
-.005"	.4601	.4549
-.010"	.4549	.4390
-.015"	.4468	.4331
-.020"	.4318	.4029

DATA COLLECTION Date/Time: 23 March 1982/
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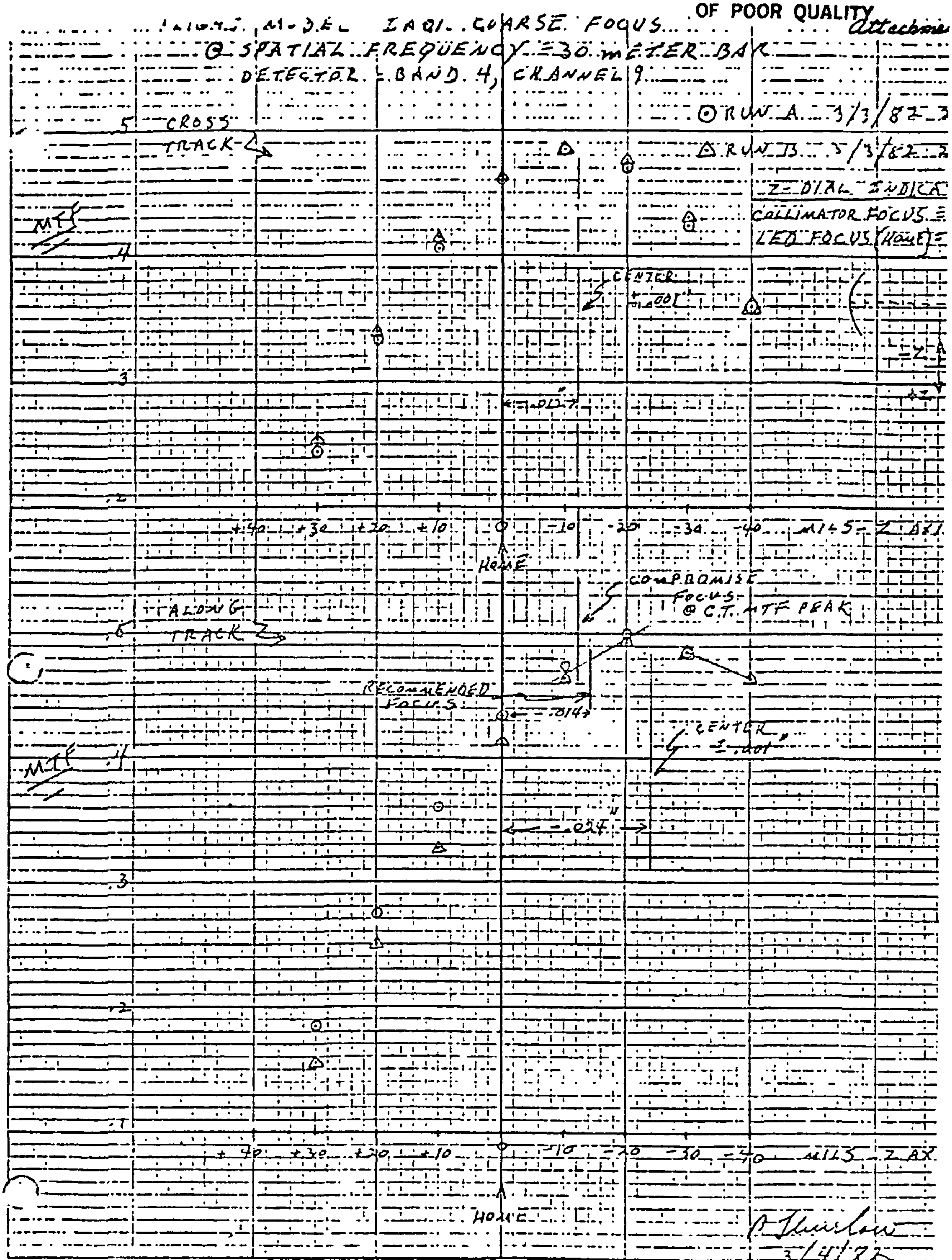

115236-7490

EUGENE DIETZGEN CO.

FIGURE

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HS236-7990

12 May '82
ATTACHMENT 12

FIGURE 2

5.4 SHIM THICKNESS DETERMINATION

5.4.1

Have systems analyst compare Scope Photos of Paragraph 5.1.6 with "COMPUTER COLLECTS" and flag differences for review.
E.K. 3-6-82

5.4.2

Call systems analyst to determine needed shim thickness.

LET:

A) T1= thickness of Shim (52055) presently in place;
T1 = ..0.250.. inch

B) F1= measured focal length of TM Telescope;
F1 = 95.995.. inch

C) F2= measured focal length of collimator in use;
F2 = .109.22. inch

D) dZ= amount modulation wheel is offset from "HOME" as determined from data generated in para. 5.2 and 5.3 (use Z-axis sign convention indicated in Fig. 4-2; and
dZ = ..-.066.. inch

DATA MASTER

E.K.
3-8-82

E) T2= calculated shim thickness.

$dz = -.066 - .014 = -.080$

$T_2 = T_1 + \left(\frac{95.995}{109.22}\right)^2(-.080)$

$T_2 = T_1 + (-.0618)$

THEN:

T2= T1 + (F1/F2)*(F1/F2)*dZ =.0.1882. inch

P. [illegible] 3/8

Report value of T2 to nearest 1/10000 inch.

And: delta T = (T2-T1) = ..-.0618. inch

T1 = .2500"
ΔT = -.0618"
T2 = .1882"

5.4.3

If a different Shim Thickness is required, this test flow must be interupted at this point and procedural control transfered to AHRS 52532.

NOTE

The fabricated shim thickness is not necessarily T2, but may have other parameters folded into the shim thickness calculation. The shim thickness should be verified by the System Engineer. [illegible] 0.188" (+0.001"

APPENDIX A

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APPENDIX A (PAGES 1–6 ATTACHED)

COARSE FOCUS SCOPE PHOTOS

HS236- 7990

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Data Control # 7-(

POLAROID PRINT DATA CARD

PROC. BK. TP32015-501 REV: G

DATA STORAGE NO:

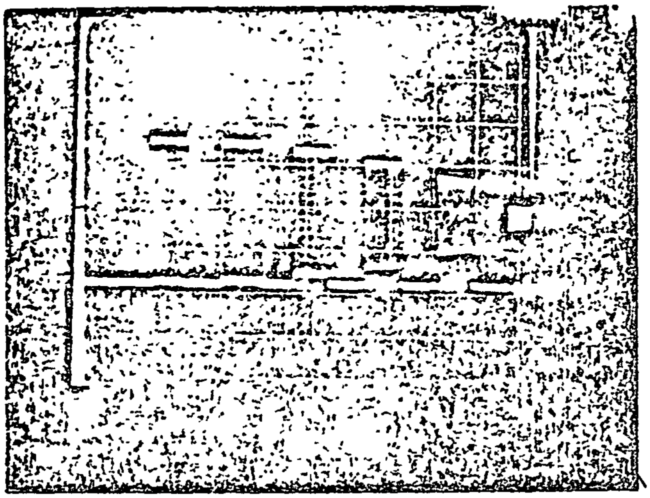
TEST TECHNIQUE: Para. 5.1.6 SUB-STEP

DATA REF. NO.

TEST DESCRIPTION: IADI TESTS

DATE: 3-1-82 TIME. 21:10

CT HOME



TRACES:

1. Band 4 det 9
@ HOME POSITION

2.
CROSS TRACK

3.

4.

~~SYNC.~~ VERT. 5 V cm

HORIZ. TIME: 0.1 MS (uncal.)

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT

TM FLIGHT MODEL

POLAROID PRINT DATA CARD

PROC. BK. REV:

DATA STORAGE NO:

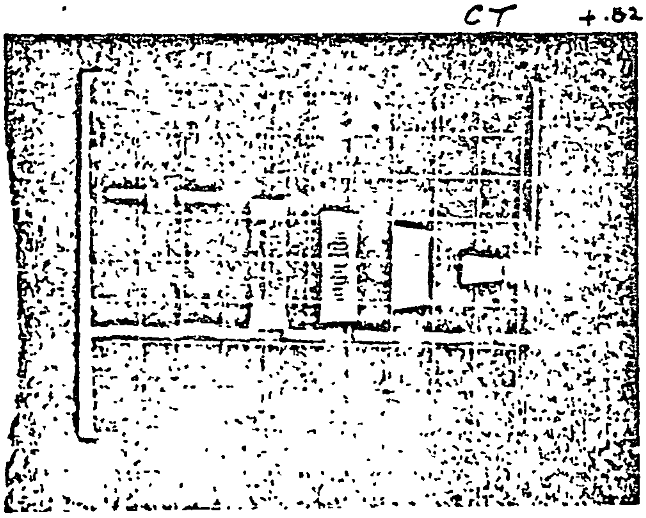
TEST TECHNIQUE. SUB-STEP

DATA REF. NO

TEST DESCRIPTION: IADI TESTS

DATE: 3-1-82 TIME: 21:15

CT +.020



TRACES:

1. Band 4 det. 9
Z @ 0.020"

2.
CROSS TRACK

3.

4.

~~SYNC.~~ V = 5 V/cm

HORIZ. TIME. 0.1 MS (uncal.)

ORIGINAL PAGE IS
OF POOR QUALITY

Data Control # 7.

POLAROID PRINT DATA CARD

PROC. BK: TP32015-501 REV C

TEST TECHNIQUE: Para. 5.1.6 SUB-STEP

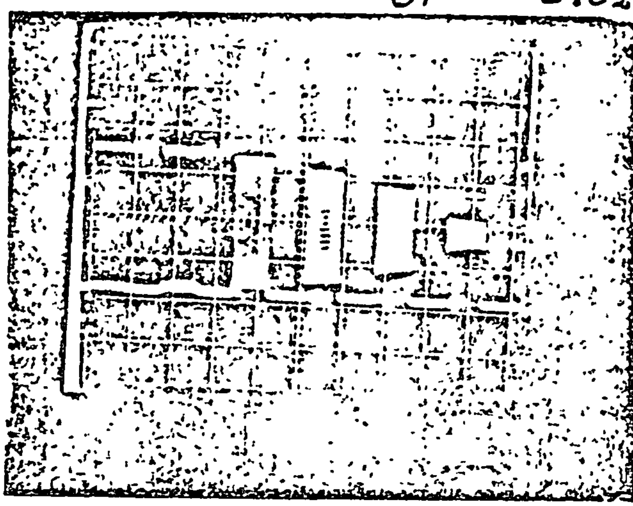
TEST DESCRIPTION: IADI TESTS

DATA STORAGE NO:

DATA REF. NO

DATE: 3-1-82 TIME: 21:30

CT -.020



TRACES:

1. Band 4 det. 9
Z @ -0.20°

2.
CROSS TRACK

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 MS (uncal.)

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMEN'

0-1007-115

TM FLIGHT MODEL

POLAROID PRINT DATA CARD

PROC. BK:

REV

TEST TECHNIQUE.

SUB-STEP

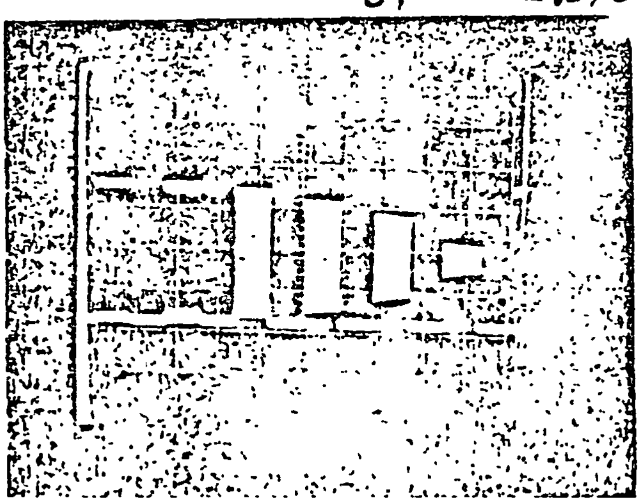
TEST DESCRIPTION: IADI TESTS

DATA STORAGE NO:

DATA REF. NO.

DATE: 3-1-82 TIME: 21:40

CT -.040



TRACES:

1. Band 4 det 9
Z @ -0.40°

2.
CROSS TRACK

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME 0.1 MS (uncal)

ORIGINAL PAGE IS
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Data Control # 7

POLAROID PRINT DATA CARD

PROC. BK: TP 32015-501 REV: G

TEST TECHNIQUE: Para. 5.1.6 SUB-STEP

TEST DESCRIPTION: EADI Tests

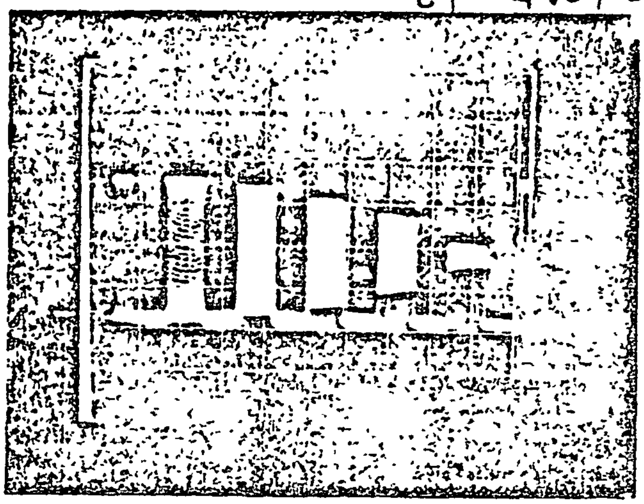
DATA STORAGE NO.

DATA REF. NO.

DATE. 3-1-82 TIME. 22:0

TM FLIGHT MODEL

CT +.040



TRACES.

1. Band 4 det 9
Z @ ~~...~~ 0.04

2. CROSS TRACK

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 MS (uncal.)

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMEN

TM FLIGHT MODEL

POLAROID PRINT DATA CARD

PROC. BK. REV:

TEST TECHNIQUE. EADI Tests SUB-STEP

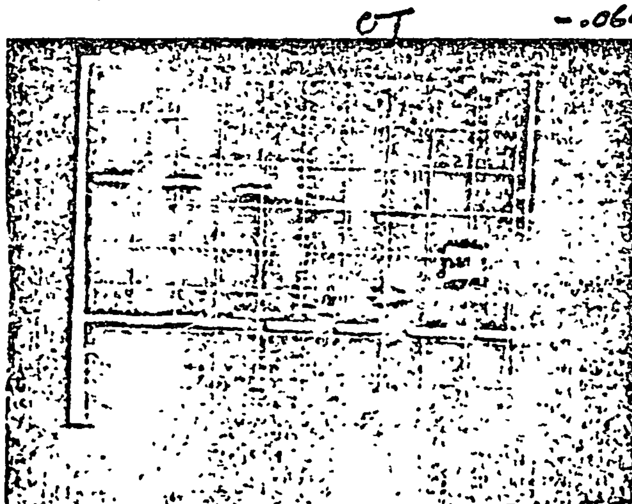
TEST DESCRIPTION:

DATA STORAGE NO:

DATA REF. NO.

DATE: 3-1-82 TIME: 22:(

CT -.060



TRACES:

1. Band 4 det 9
Z @ -0.060"

2. CROSS TRACK

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME. 0.1 MS (uncal)

ORIGINAL PAGE IS
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Data Control # 7

POLAROID PRINT DATA CARD

PROC. BK: TP32015-501 REV: G

DATA STORAGE NO:

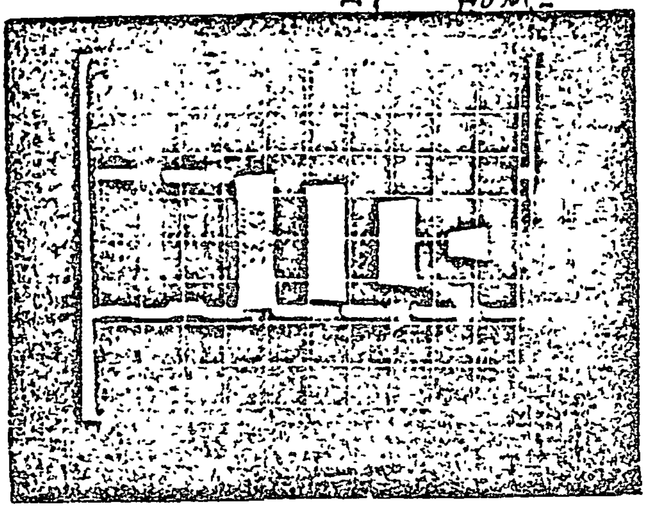
TEST TECHNIQUE: Para 5.1.6 SUB-STEP

DATA REF. NO:

TEST DESCRIPTION: IAS1 tests

DATE: 3-1-82 TIME: 22:3

AT HOME



TRACES:

1. Band 4 det 9
@ HOME POSITION

2. ALONG TRACK

3.

4.

SYNC. V = 5V/cm

HORIZ. TIME: 0.1 MS (uncal.

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMEN

TM FLIGHT MODEL

POLAROID PRINT DATA CARD

PROC. BK: REV:

DATA STORAGE NO:

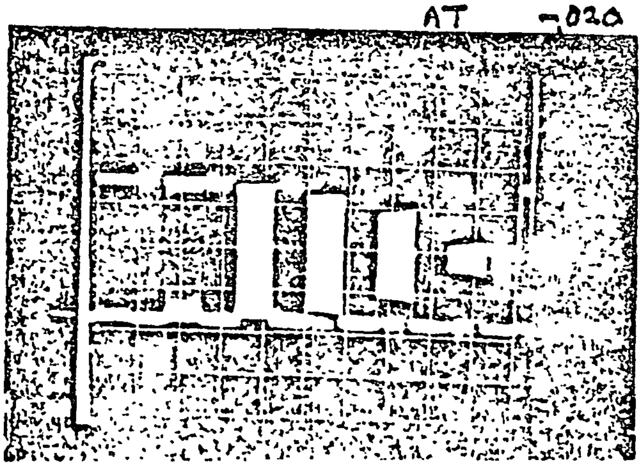
TEST TECHNIQUE: SUB-STEP

DATA REF. NO:

TEST DESCRIPTION: IAS1 tests

DATE: 3-1-82 TIME: 22:4

AT -.020



TRACES:

1. B4 det 9
Z @ -0.020"

2. ALONG TRACK

3.

4.

SYNC. V = 5V/cm

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Data Control # 7-(

POLAROID PRINT DATA CARD

PROC. BK: TP32015-501 REV: 6

DATA STORAGE NO:

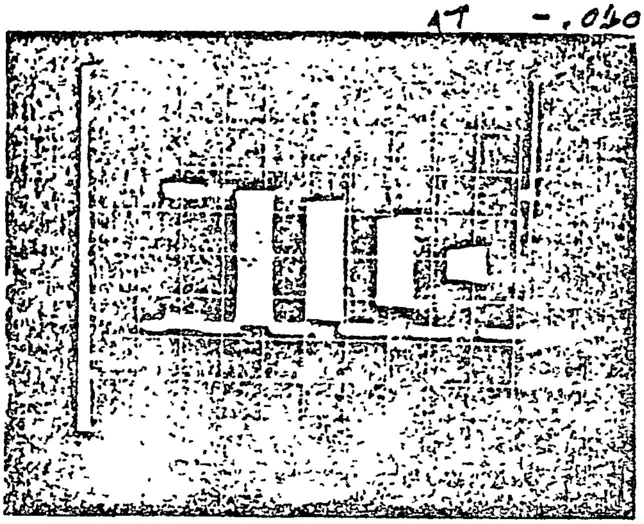
TEST TECHNIQUE: Para. 5.1.6 SUB-STEP

DATA REF. NO:

TEST DESCRIPTION: IA01 tests

DATE: 3-1-82 TIME: 22:50

ΔT -.040



TRACES:

1. Band 4 det. 9
   Z @ -0.040°
2. ALONG TRACK
3.
4.

SYNC: V = 5 V/cm

HORIZ. TIME: = 0.1 MS (uncal.)

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

TM FLIGHT MODEL

POLAROID PRINT DATA CARD

PROC. BK. REV:

DATA STORAGE NO.

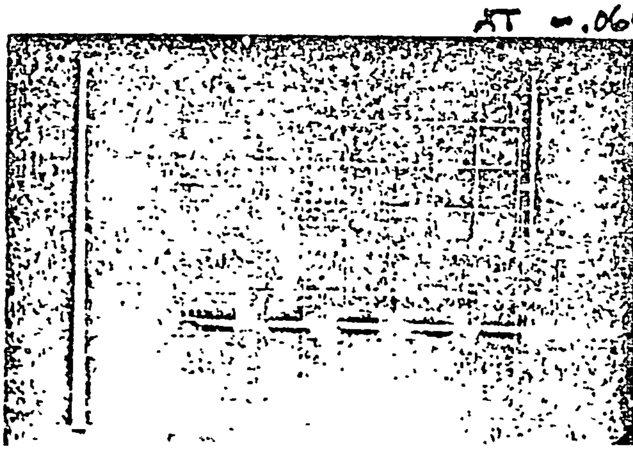
TEST TECHNIQUE: SUB-STEP

DATA REF. NO:

TEST DESCRIPTION. IA01 tests

DATE: 3-1-82 TIME. 23:00

ΔT -.060



TRACES:

1. Band 4 det 9
   Z@ -0.160°
2. ALONG TRACK
3.
4.

V = 5V/cm

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Data Control # 7-01:

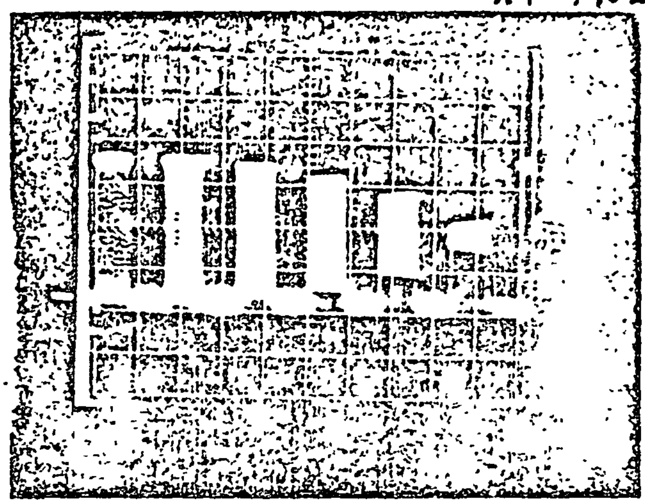
POLAROID PRINT DATA CARD

PROC. BK: TP32015-501 REV. G DATA STORAGE NO.

TEST TECHNIQUE. Para 5.1.6 SUB-STEP DATA REF. NO

TEST DESCRIPTION. IA01 tests DATE 3-1-82 TIME 23:10

AT +.020



TRACES:

1. Band 4 det 9
Z @ 0.020"

2. ALONG TRACK

3.

4.

SYNC V = 5V/cm

HORIZ. TIME. 0.1 MS (uncal.)

NOTE. USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007 115

TM FLIGHT MODEL

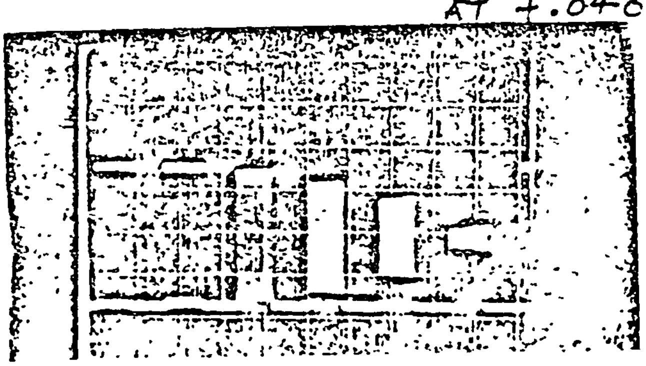
POLAROID PRINT DATA CARD

PROC. BK: REV. DATA STORAGE NO

TEST TECHNIQUE: SUB STEP DATA REF. NO

TEST DESCRIPTION. IA01 tests DATE 3-1-82 TIME. 23:20

AT +.040



TRACES:

1. Band 4 det 9
Z @ 0.040"

2. ALONG TRACK

3.

4.

3.2.2 IA03 TEST

Band 5 & 7 Focus, Baffle Check

Test Summary: HS236-8008 E.M. Kelly

Test Specification: TP32015-503(E) Cold Focal Plane Coarse Focus Test Procedure

Reference Documentation: HS236-8005; IA03R Coarse Focus Determination, Cold Focal Plane; W.J. O'Donnell; 22 May 198[illegible]

SANTA BARBARA RESEARCH CENTER
A Subsidiary of Hughes Aircraft Company
INTERNAL MEMORANDUM

TO: TM Distribution
Systems Test Reports

CC:

DATE: ~~28 May 1982~~

REF: HS236-8008
SED-104

FROM: E. M. Kelly

SUBJECT: IA03R TEST RESULT SUMMARY,
TM Flight Model

BLDG. B11 MAIL STA. 101
EXT. 6378

REFERENCES

1. TP32015-503(E), Cold Focal Plane Coarse Focus Test Procedure (IA03R).
2. History Tape #D03018.
3. BTCE #2 Event Log for Period 28 April thru 30 April 1982.
4. O'Donnell, W. J., "IA03R Coarse Focus Determination, Cold Focal Plane," HS236-8005, dated 22 May 1982.

SUMMARY

This report contains the key results of IA03R tests performed on 28 April thru 30 April 1982, per Test Procedure TP32015-503(E). The results were used for the determination of:

1. Initial focus position of CFPA.
2. The shim thickness needed at Radiative Cooler Adapter to place CFPA within focus range of inchworms.

TEST CONFIGURATION DOCUMENTATION

The test reported herein is an integration-level test performed on the Thematic Mapper(TM) Telescope/Aft Optics Assembly; it is a collimator-type test that uses image quality measurements to guide initial cold focal plane positioning.

This test was performed to axially position the Radiative Cooler Assembly, such that the Cold Focal Plane Array (CFPA) of Bands 5, 6 and 7 is placed at the relayed focus of the telescope within trimming range of the inchworm adjustments. A positional specification of $\pm$ .015 inch has been established as the allowable deviation from the optimum focal position indicated by a central Band 5 detector during this test.

TEST CONFIGURATION DOCUMENTATION (continued)

The test was conducted with the TM Telescope/Aft Optics Assembly mounted in the TM main frame and oriented to align the optical axes of the TM Telescope and the Collimator.

Axial positioning of the Radiative Cooler relative to its interface with its Adapter to the Telescope Housing was determined by calculating the Modulation Transfer Function (MTF) of a Band 5 central detector. These MTF data were then maximized by shim thickness trimming at the Radiative Cooler and Adapter interface until the correct shim thickness has been determined. This final shim thickness was then manufactured and installed to maintain this proper focus.

TEST RESULTS

This section summarizes the data which resulted from running the IA03 R test procedure. Table 1 summarizes the specific tests and their test conditions. This table lists each test by name and its section in the IA03R procedure. As noted in the table,"Z-Axis Focus Range" and "Z-Axis Steps" refer to motion of the MTF wheel from its "Home" position at the Focal Plane of the Collimator. The"Collimator to TM Alignment" column lists the location in the TM Prime Focal Plane with which the Collimator axis is aligned during each test.

Table 2 summarizes the results of the Coarse Focus Tests, in cross and along track modes. Figure 1 contains plots which are derived from these Coarse Focus Tests. Figure 2 is a copy of the page in the Data Master where the new shim thickness value was computed.

Appendix A contains a copy of the Oscilloscope Photos placed in the Data Master; the tabulated MTF values may be compared with the SWR values which may be obtained from these scope traces.

DISCUSSION AND CONCLUSIONS

On 28 April 1982, during pre-IA03 set-up and check-out, some Band 5 video detectors appeared to have low signal levels. We ran an open-pattern-value collect (IVTA ·DSL) and, for troubleshooting purposes, a reverse O-P-V collect (IVTA REV ·DSL). This method enabled us to check all detectors of Bands 5 and 7 through both System Interface Unit(SIU) Channels("A" and "B"). From these collects we determined that Band 5: Det. 1 (Ch A), Det. 4 (Ch A), Det. 5 (Ch A) and Det. 9 (Ch A and B) all had low signal levels.

DISCUSSION AND CONCLUSIONS (continued)

Further investigation determined that it was a test equipment problem, maybe inside the SIU. Consequently, in Band 5, we used Detector 8 instead of Detector 9 in our subsequent tests: Scope Photos (Para.5.1.6) and Coarse Focus (Para.5.2).

On 29 April 1982, during further troubleshooting, scope photos were taken: at "Home" (0.000"), +0.040" and +0.080," but the photos showed only insignificant change of scope SWR values (see APPENDIX A, Scope Photos taken 14:35 to 15:05). Then we looked at Band 4 Det. 8 and Band 7 Det. 8 for comparison (see Scope Photos taken 16:50 and 16:55). Results showed that Band 4 Det. 8 was at peak focus, whereas Band 7 Det.8 video was low--comparable to Band 5 Det. 8 (since they are both Cold Bands). Further investigation of "best" focus revealed that it peaked at approximately +0.300" (see Scope Photos taken 17:00 to 17:35). Using best focus of +0.300" as Z-Axis "Home," we successfully ran the Coarse Focus Test (IA3CFF.DSL) in cross track mode.

On 30 April 1982 we first took the Along Track Scope Photos (see Appendix A, photos taken at 10:15 to 10:45). Then we successfully completed the Coarse Focus Test (IA3CFF.DSL) by running in the along track mode. Finally we took the Cross Track Scope Photos (see photos taken at 13:00 to 13:15, plus HOME photo taken 16:30 on 29 April 1982). Z-Axis HOME scope trace was observed (on 30 April 1982) to be identical to the scope photo of the previous day. Band 5 Det. 8 results showed peak MTF at collimator focus of:

Cross Track = 0.289"

Along Track = 0.310"

From this data it was determined that a shim thickness of 0.1878" was required for the Radiative Cooler and Adapter interface. Original shim was 0.132", giving a change of:

0.1878" - 0.132" = 0.0558"

(See Figure 2)

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DISCUSSION AND CONCLUSIONS (continued)

For more detailed computation see Ref. 4 memo.

E.M. Kelly

E.M. Kelly
Test Director

D.G. Brandshaft

D.G. Brandshaft
Systems Engineer/Optics
Analyst

Approved by:

G.S. Plews, Manager
Systems Integration & Test

Release Approval:

for
J.L. Engel, Manager
Systems Engineering Dept.

EMK:pg

Attachments: 8 + Appendix A (Pgs. 1-14)
Distribution for IA03

TABLE 1

SUMMARY OF IA03 TESTS

TP PARA.	TEST NAME	DATE (1982)	B/D USED	Z-AXIS STEPS	Z-AXIS FOCUS RANGE	COLL TO TM ALIGNMENT
5.1.6	"SCOPE	4/29	5/8	-	± 0.040"	ON-AXIS
(CT)	PHOTOS"	4/29	5/8	-	± 0.080"	ON-AXIS
5.1.6	"SCOPE	4/30	5/8	-	± 0.040"	ON-AXIS
(AT)	PHOTOS"	4/30	5/8	-	± 0.080"	ON-AXIS
5.2	CF(CT)	4/29	5/8	.020"	± 0.080"	ON-AXIS
5.2	CF(AT)	4/30	5/8	.020"	± 0.080"	ON-AXIS

NOTES:

(1) Above tests indicate runs with complete valid data collects, with "HOME" at "best focus" of CFPA.

(2) CF = Coarse Focus Test   CT = Cross Track Test Mode
AT = Along Track Test Mode

TABLE 2

(30 METER BAR PATTERN)

(BAND 5 DETECTOR 8)

Z POSITION	CT MTF	AT MTF
+.080	.0829	.0275
+.060	.0207	.1583
+.040	.1387	.3076
+.020	.3200	.4060
.000	.4346	.4192
-.020	.4516	.3445
-.040	.3562	.1717
-.060	.1744	.0302
-.080	.0566	.1041

DATA COLLECTION: Date/Time: (CT) 29 April 1982/17:10

(AT) 30 April 1982/10:40

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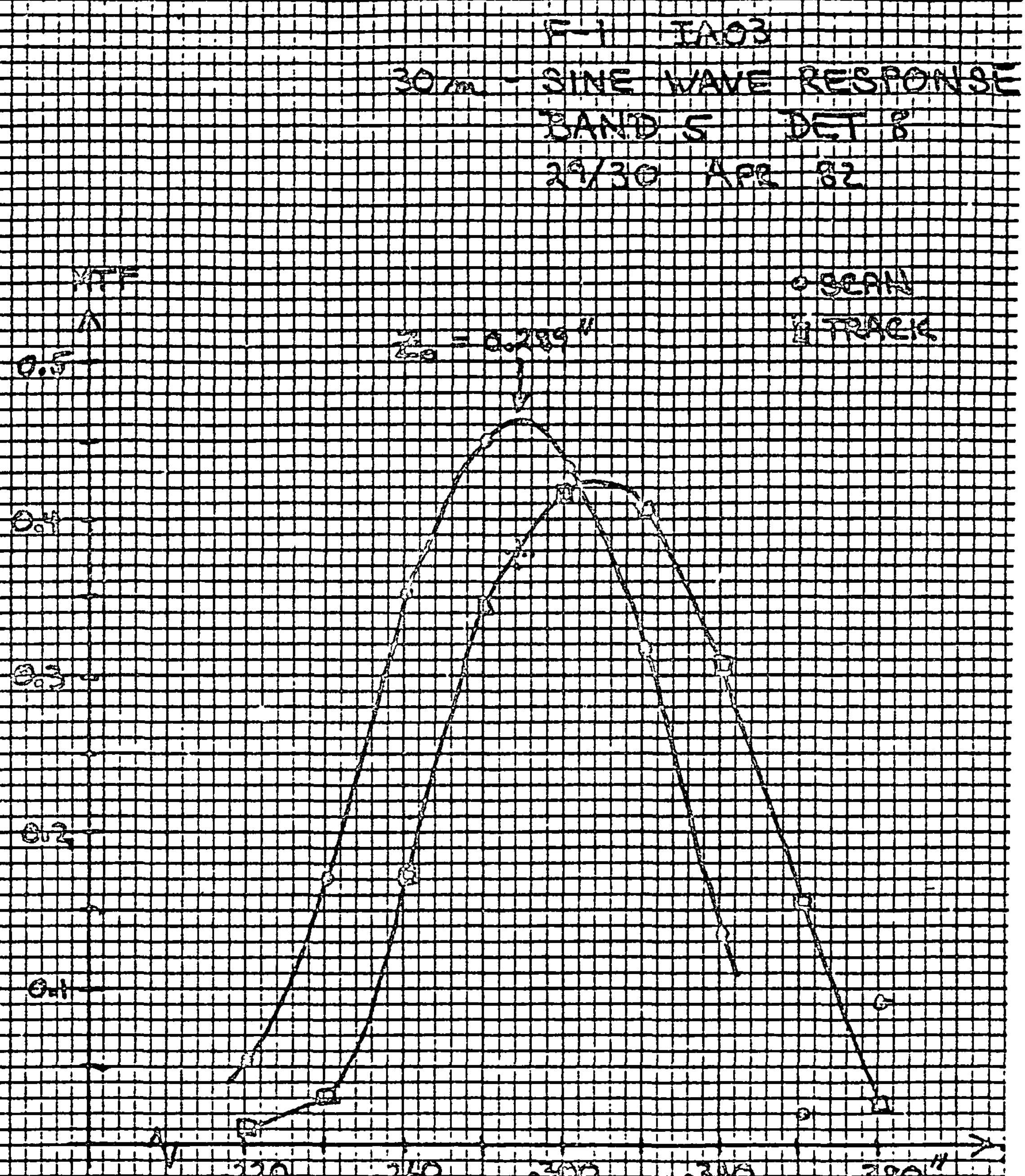

$$\Delta T = -\left[\frac{F_{TM}/2}{F_{COLL}}\right]^2 \times Z_0$$

$= +0.0558"$

$F_{TM} = 95.995"$

$F_{COLL} = 109.22"$

$Z_0 = 0.289"$

K·E 5 X 5 TO 1/2 INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 0863

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5.3 SHIM THICKNESS DETERMINATION

5.3.1

Call systems analyst to determine the Radiative Cooler needed shim thickness.

LET:

A) T1= thickness of Shim (52051) presently in place;
B) F1= measured focal length of TM Telescope times 0.5;
C) F2= measured focal length of collimator in use;
D) dZ= amount modulation wheel is offset from "HOME" (use Z-axis sign convention indicated in Fig. 4-2); and
E) T2= new shim thickness.

T1= ......0.132... inch
F1= ...95.995/2... inches RB 5/5/82

DATA MASTER

F2= ....109.22.... inches
dZ= ....0.289.... inch
R.K. 5-5-82

THEN:

T2 = T1 + (F1/F2)*(F1/F2)*dZ= ...0.1878. inch

Report value of T2 to nearest 1/10000 inch.

THEREFORE:

delta T = (T2-T1)= ....0.0558.... inch RB 5/5/82

5.3.2

✓ Power down equipment not required during the fabrication of the new Radiative Cooler shim.
9.12 4-30-82

5.3.3

✓ Remove Radiative Cooler per AHRS 52532.
5/8/82

5.3.4

✓ Perform "Vignetting Test" per Appendix I, while new shim i

HS236-8008

Appendix A
28 May 1982

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APPENDIX A

COARSE FOCUS SCOPE PHOTOS

(PAGES 1-14 ATTACHED)

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POLAROID PRINT DATA CARD

PROC. BK: TP 2015-503 REV: E

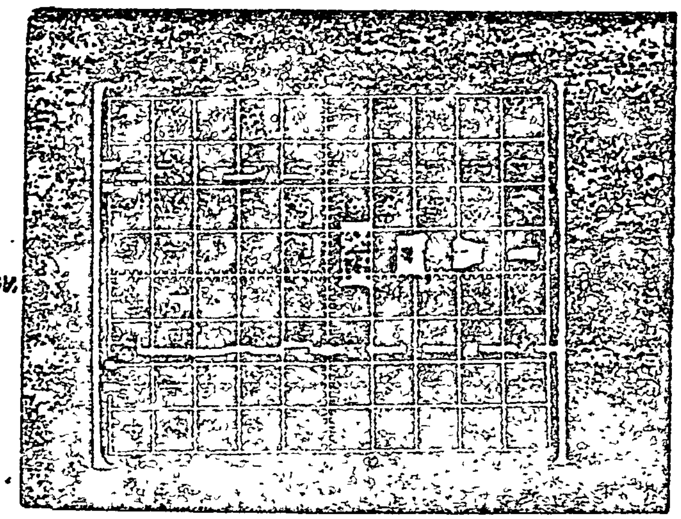
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO ______

DATA REF. NO: ______

DATE: 4-29-82 TIME: 14:35



CV.

TRACES.

1. Z @ Home (.0000")
Band 5 Det 8

2. ______

3. ______

4. ______

SYNC V = 5 V/cm

HORIZ. TIME: 0.1 sec (uncal)/cm

NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

— F-1 — CROSS TRACK

(1st run)

— PRE TROUBLESHOOTING —

POLAROID PRINT DATA CARD

PROC. BK. TP 32015-503 REV: E

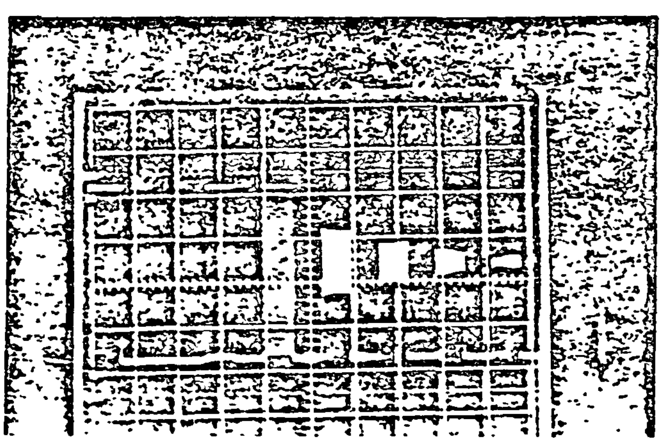
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO. ______

DATA REF. NO: ______

DATE: 4-28-82 TIME 14:45



TRACES.

1. Band 5 Det 8

2. Z @ +0.020"

3. ______

4. ______

SYNC V = 5 V/cm

D-1007-115
HS 236-7990

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMME

APPENDIX A - Page 47

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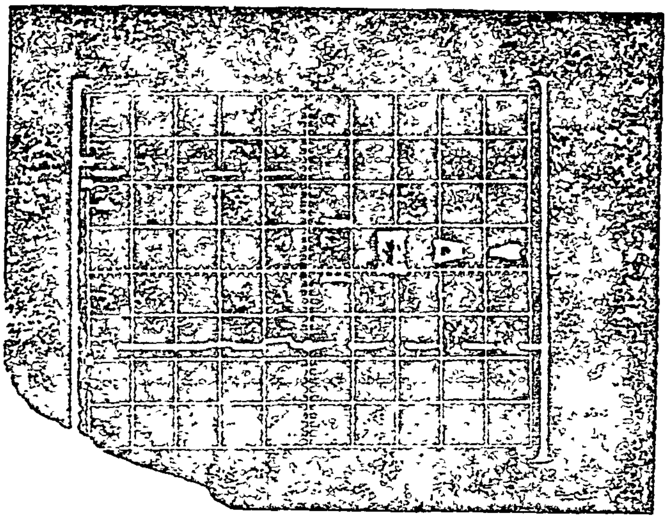
POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV. E
DATA STORAGE NO.
TEST TECHNIQUE SUB-STEP 5.1.6
DATA REF. NO.
TEST DESCRIPTION: SCOPE PHOTOS
DATE. 4-29-82 TIME: 14:50



TRACES.
1. Band 5 Det 8
2. Z @ +0.040"
3.
4.
~~SYNC~~ V = 5 V./cm
HORIZ. TIME: 0.1 sec (msec)/cm

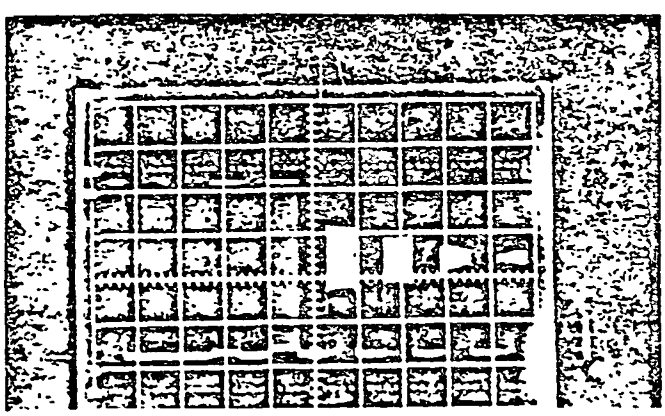
NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

F-1 CROSS-TRACK

(1st run)
— PRE-TROUBLESHOOT

POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV. E
DATA STORAGE NO
TEST TECHNIQUE SUB-STEP 5.1.6
DATA REF. NO
TEST DESCRIPTION: SCOPE PHOTOS
DATE. 4-29-82 TIME. 14:55



TRACES
1. Band 5 Det. 8
2. Z @ +0.080"
3.
4.

0-1007-115
MS 236-7990

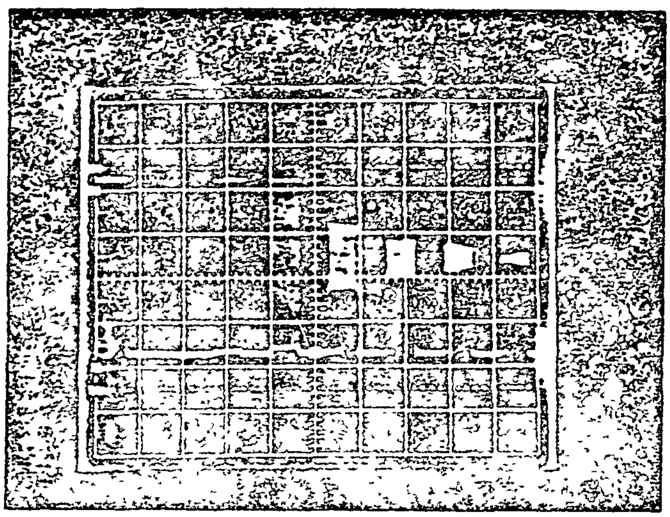
NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT

APPENDIX A - Page 5 of 6

ORIGINAL PAGE IS OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK: TP 32015-503 REV: E
DATA STORAGE NO
TEST TECHNIQUE: SUB-STEP 5.1.6
DATA REF. NO:
TEST DESCRIPTION: SCOPE PHOTOS
DATE: 4-29-82 TIME: 15:00



TRACES.
1. Band 5 Det. 8
2. Z @ -0.040"
3.
4.
SYNC. V = 5 V/cm
HORIZ. TIME: 0.1 sec (ms) /cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT

0-1007-115

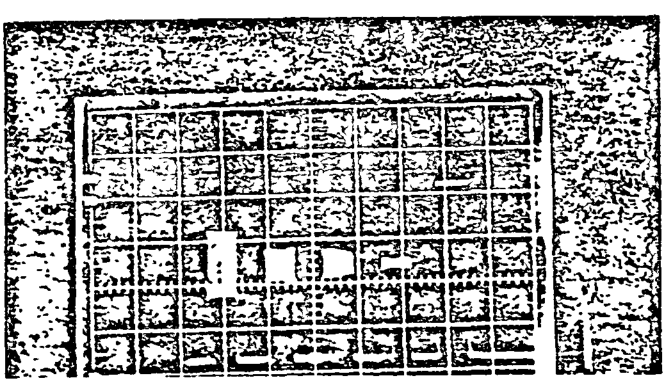
F-1 CROSS-TRACK

(1st run)

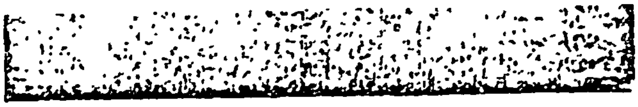
— PRE-TROUBLESH

POLAROID PRINT DATA CARD

PROC. BK. TP 32015-503 REV: E
DATA STORAGE NO:
TEST TECHNIQUE SUB-STEP 5.1.6
DATA REF. NO:
TEST DESCRIPTION: SCOPE PHOTOS
DATE: 4-29-82 TIME: 15:05



TRACES.
1. Band 5 Det 8
2. Z @ -0.080"
3.
4.



HORIZ. TIME 0.1 HS (uncal.)

HS 236-7990

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

APPENDIX A—Page 6 of 26

ORIGINAL PAGE IS OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK TP 32615-218 REV. E

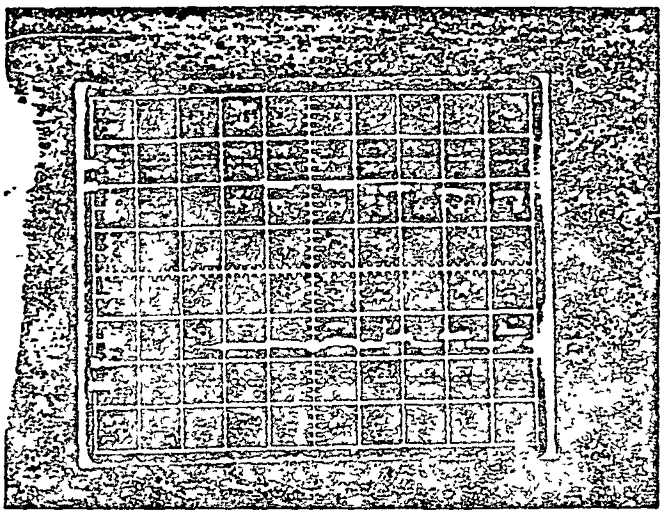
DATA STORAGE NO

TEST TECHNIQUE SUB-STEP 5.1.6

DATA REF NO

TEST DESCRIPTION: SCOPE PHOTOS

DATE: 4-29-92 TIME ≈16:50



TRACES:

1. Band 4 Det 8

2. Z @ Home (.5000°)

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 (uncal)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

F-1 (CROSS-TRACK) TROUBLE-SHOOTING & checking for BEST FOCUS

POLAROID PRINT DATA CARD

PROC. BK. REV:

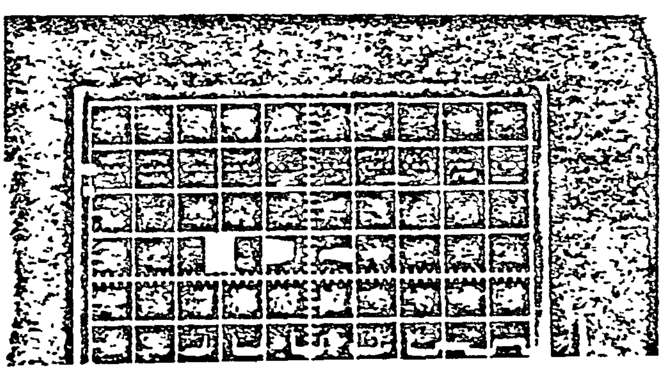
DATA STORAGE NO

TEST TECHNIQUE. SUB-STEP

DATA REF. NO

TEST DESCRIPTION:

DATE. 4-29-92 TIME. ≈16:55



TRACES

1. Band 7 Det 8

2. Z @ Home (.0000°)

3.

4.

POLAROID PRINT DATA CARD

PROC. BK. TP 3 115-113 REV: E

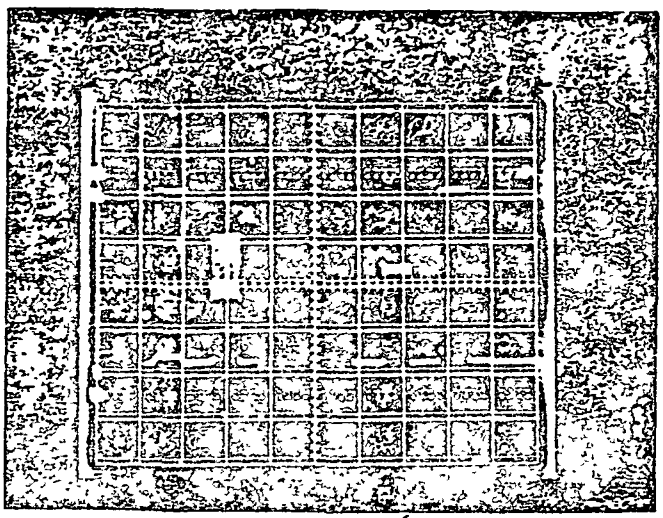
TEST TECHNIQUE ______ SUB STEP 5.1.6

TEST DESCRIPTION. SCOPE PHOTOS

DATA STORAGE ORIGINAL PAGE IS ~~OF POOR QUALITY~~

DATA REF. NO ______

DATE 4/29/82 TIME: ≈ 17:00



Z@ −.040"

TRACES:

1. Band 5 Det 8
2. Z @ −0.040"
3.
4.

SYNC. V = 5 V/cm

HORIZ. TIME: 0.1 sec(med.)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 (CROSS-TRACK) TROUBLE-SHOOTING FOR BEST FOCUS

POLAROID PRINT DATA CARD

PROC. BK ______ REV· ______

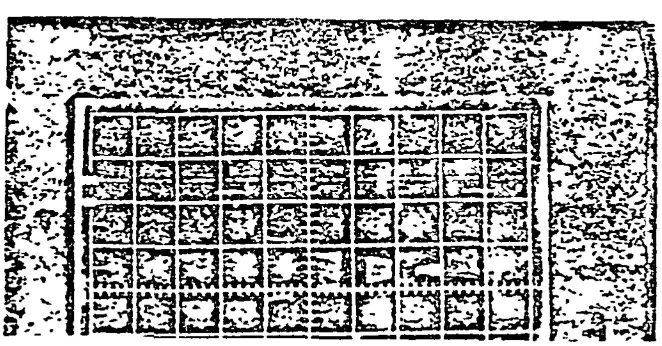
TEST TECHNIQUE ______ SUB-STEP ______

TEST DESCRIPTION: ______

DATA STORAGE NO ______

DATA REF. NO· ______

DATE: 4/29/82 TIME: ≈ 17:05



TRACES.

1. Band 5 Det 8
2. Z @ + 0.005"
3.
4.

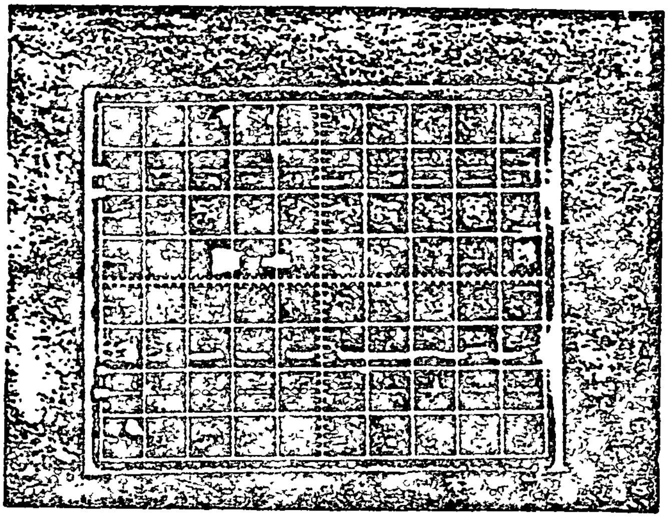
ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK: TP32015-503 REV: C DATA STORAGE NO: ______

TEST TECHNIQUE. ______ SUB-STEP 5.1.6 DATA REF. NO: ______

TEST DESCRIPTION: SCOPE PHOTOS DATE: 4-29-82 TIME: ≈17:10



Z @ +0.050"

TRACES.

1. Band 5 Det 8
2. Z @ +0.050"
3. ______
4. ______

SYNC: V = 5 V/cm

HORIZ. TIME: 0.1 sec(uncal)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

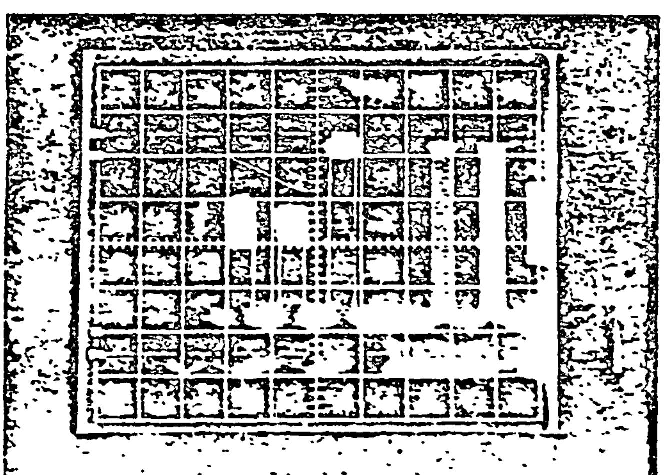
F-1 (CROSS-TRACK) TROUBLE-SHOOTING for BEST FOCUS

POLAROID PRINT DATA CARD

PROC. BK ______ REV: ______ DATA STORAGE NO: ______

TEST TECHNIQUE ______ SUB-STEP ______ DATA REF. NO: ______

TEST DESCRIPTION: ______ DATE: 4-29-82 TIME: ≈17:15



Z @ +0.150"

TRACES

1. Band 5 Det 8
2. Z @ +0.150"
3. ______
4. ______

SYNC V = 5 V/cm

HORIZ TIME 0.1 sec(uncal)/cm

NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

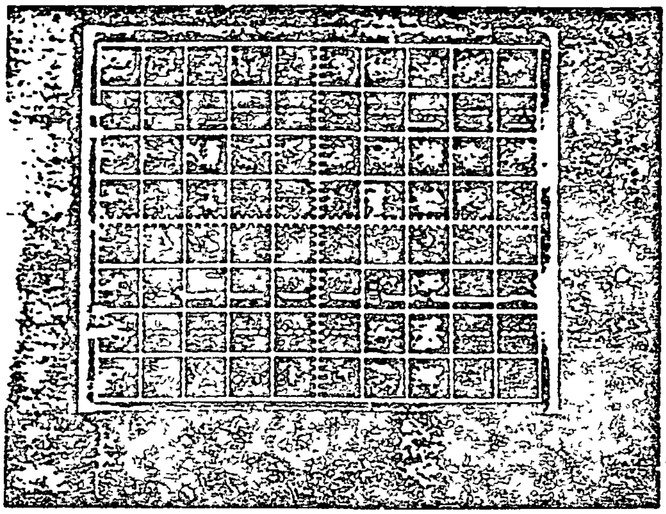
ORIGINAL PAGE IS OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV: G DATA STORAGE NO:

TEST TECHNIQUE SUB-STEP 5.1.6 DATA REF. NO:

TEST DESCRIPTION: SCOPE PHOTOS DATE: 4-29-82 TIME: ≃17:20



Z@+0.200"

TRACES.

1. Band 5 Det 8

2. Z @ +0.200"

3.

4.

SYNC: V = 5 V/cm

HORIZ. TIME: 0.1 sec (uncal)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

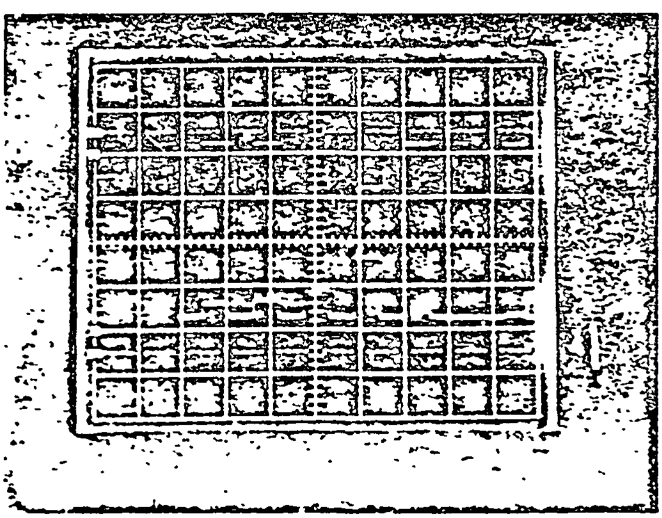
F-1 (CROSS-TRACK) TROUBLE-SHOOTING for BEST FOCUS

POLAROID PRINT DATA CARD

PROC. BK REV: DATA STORAGE NO:

TEST TECHNIQUE. SUB-STEP DATA REF. NO:

TEST DESCRIPTION: DATE: 4-29-82 TIME ≃17:25



Z@+0.250"

TRACES.

1. Band 5 Det 8

2. Z @ +0.250"

3.

4.

SYNC V = 5 V/cm.

HORIZ. TIME 0.1 sec (uncal)/cm

NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007 115 HS 236-8008

ORIGINAL PAGE IS OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK. TP 32015-523 REV: E

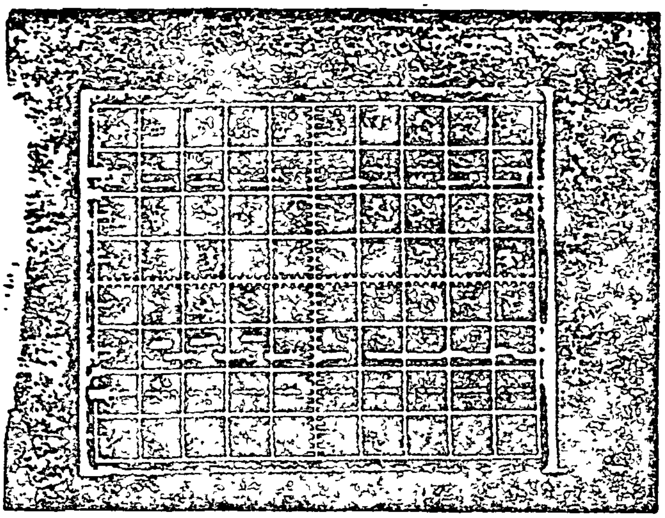
TEST TECHNIQUE: SUB-STEP 5.1.6

TEST DESCRIPTION Scope Photos

DATA STORAGE NO:

DATA REF. NO:

DATE. 4-29-82 TIME ≈17:30



Z @ +0.300"

TRACES:

1. Band 5 Det 8

2. Z @ +0.300"

3.

4.

SYNC V = 5V/cm

HORIZ. TIME: 0.1 sec (word)

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 (CROSS-TRACK) TROUBLE-SHOOTING for BEST FOCUS

POLAROID PRINT DATA CARD

PROC. BK REV:

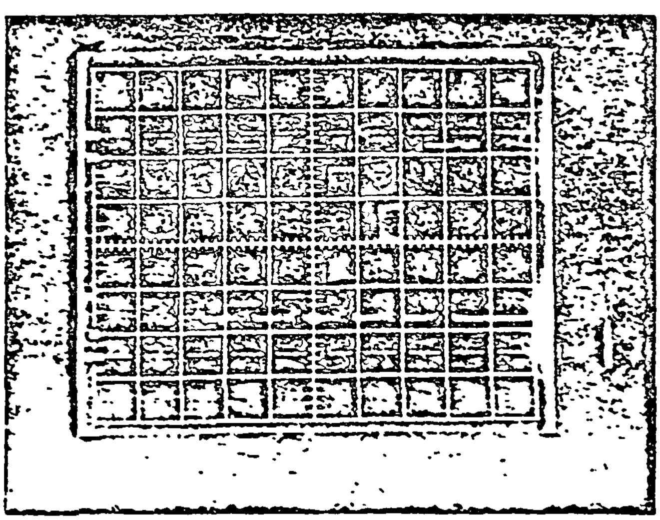
TEST TECHNIQUE. SUB-STEP

TEST DESCRIPTION:

DATA STORAGE NO

DATA REF. NO

DATE: 4-29-82 TIME. ≈17:35



Z@ +0.350"

TRACES:

1. Band 5 Det 8

2. Z @ +0.350"

3.

4.

SYNC V = 5V/cm

HORIZ. TIME 0.1 sec. (word)/cm

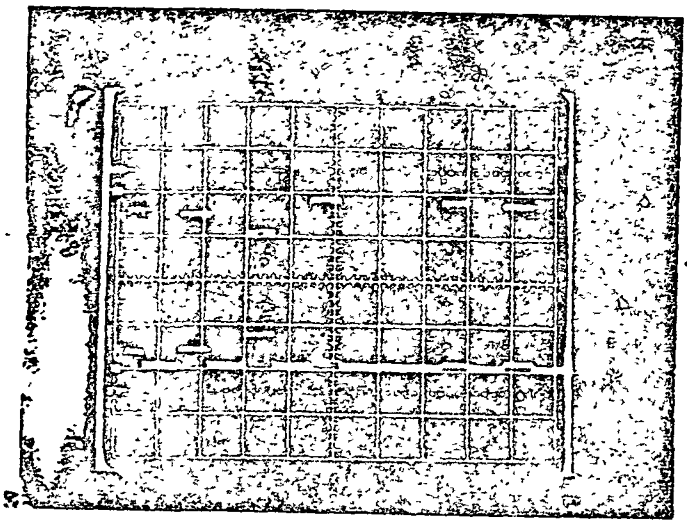
NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115 HS 236-8000

ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK: TP 32015-503 REV: E
TEST TECHNIQUE: ________ SUB-STEP 5.1.6
TEST DESCRIPTION: SCOPE PHOTOS
DATA STORAGE NO: ________
DATA REF. NO: ________
DATE: 4-30-82 TIME: 10:15



TRACES:
1. Band 5 Det 8
2. Z @ Home (actually +0.300
3. ________
4. ________

SYNC: V = 5V/cm
HORIZ. TIME: 0.1 sec (uncal)/cm

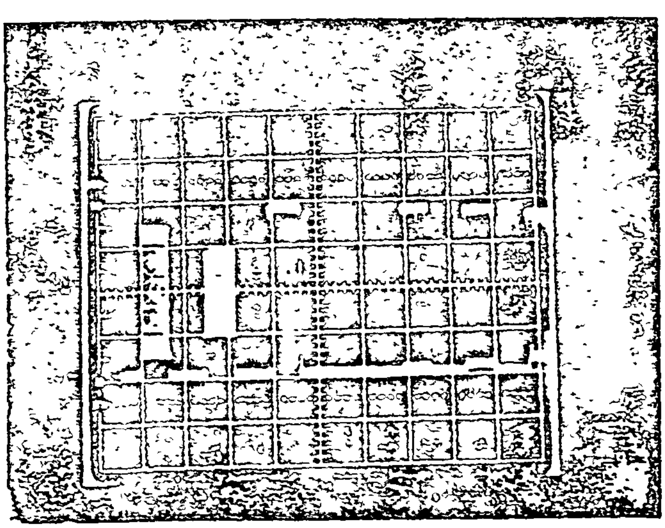
NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 ALONG TRACK (Pre A.T. Collect)

POLAROID PRINT DATA CARD

PROC. BK: TP 32015-503 REV: E
TEST TECHNIQUE: ________ SUB-STEP 5.1.6
TEST DESCRIPTION: SCOPE PHOTOS
DATA STORAGE NO. ________
DATA REF. NO: ________
DATE: 4-30-82 TIME: 10:20



TRACES:
1. Band 5 Det 8
2. Z @ +0.040°
3. ________
4. ________

SYNC: V = 5V/cm
HORIZ. TIME: 0.1 sec (uncal)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115 HS236-8008

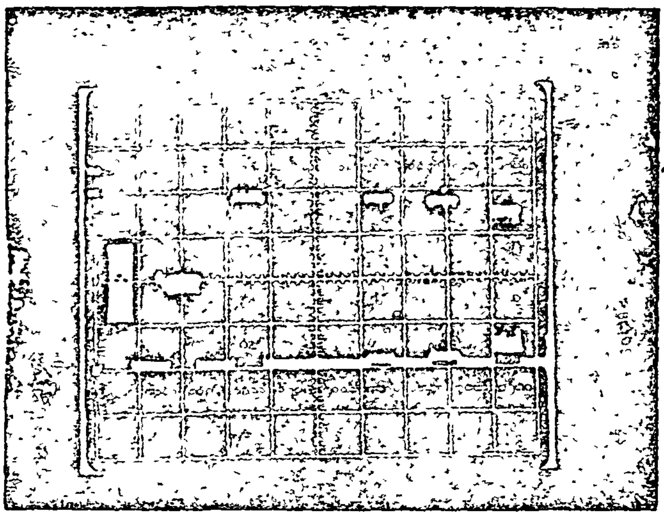
ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK. TP 32015-503 REV: E DATA STORAGE NO. ____

TEST TECHNIQUE: ____ SUB-STEP 5.1.6 DATA REF. NO: ____

TEST DESCRIPTION: SCOPE PHOTOS DATE: 4-30-82 TIME: 10:35



TRACES:

1. Band 5 Det 8
2. Z @ +0.080"
3. ____
4. ____

SYNC. V = 5 V/cm

HORIZ. TIME: 0.1 sec (usual)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

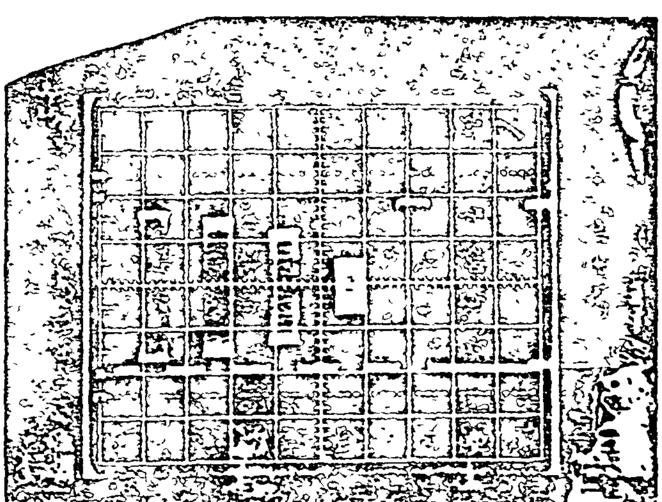
F-1 ALONG TRACK (for A.T. Collect)

POLAROID PRINT DATA CARD

PROC. BK. TP 32015-503 REV: E DATA STORAGE NO ____

TEST TECHNIQUE. ____ SUB-STEP 5.1.6 DATA REF. NO: ____

TEST DESCRIPTION: SCOPE PHOTOS DATE. 4-30-82 TIME. 10:40



TRACES.

1. Band 5 Det 8
2. Z @ -0.040"
3. ____
4. ____

SYNC. V = 5 V/cm

HORIZ. TIME 0.1 sec (usual)/cm

NOTE USE REVERSE SIDE OF CARD FOR ...

0-1007-115 HS 236-EMO

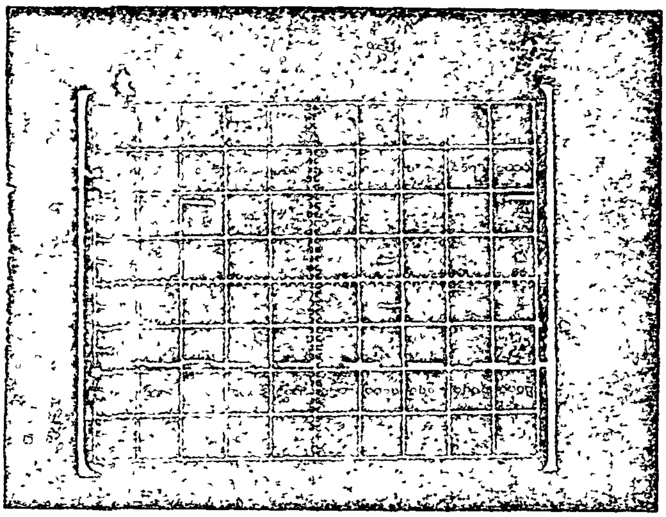
ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV: E DATA STORAGE NO

TEST TECHNIQUE: SUB-STEP 5.1.6 DATA REF. NO:

TEST DESCRIPTION: SCOPE PHOTOS DATE: 4-30-82 TIME: 10:45



TRACES:

1. Band 5 Det 8

2. Z @ -0.080°

3.

4.

SYNC: V = 5 V/cm

HORIZ. TIME: 0.1 sec (uncal)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 ALONG TRACK (Pre A.T. Colbst)

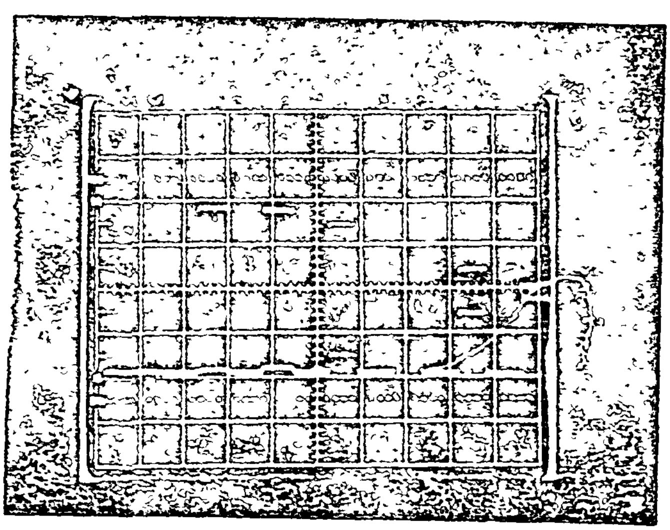
POLAROID PRINT DATA CARD

PROC. BK. REV: DATA STORAGE NO

TEST TECHNIQUE: SUB-STEP DATA REF. NO:

TEST DESCRIPTION. DATE. 4-30-82 TIME. 10:50

DUPLICATE PHOT



TRACES.

1. Band 5 Det 8

2. Z @ -0.080°

3.

4.

SYNC V = 5 V/cm

HORIZ. TIME 0.1 sec (uncal.)/cm

ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV E

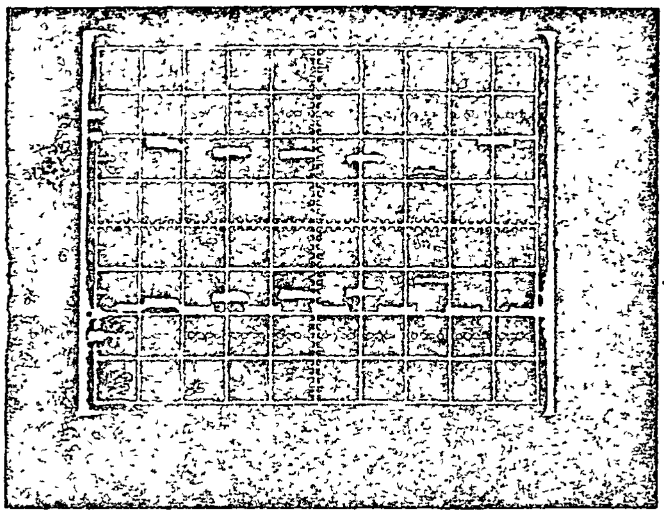
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO. ______

DATA REF. NO: ______

DATE: 4-29-82 TIME: 16:30



TRACES:
1. Band 5 Det. 8
2. Z @ HOME (actually +0.3
3.
4.

SYNC V = 5V/cm

HORIZ. TIME: 0.1 sec (uncal) /cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 CROSS-TRACK (FINAL RUN) (Post-test recheck,

POLAROID PRINT DATA CARD

PROC. BK. TP32015-503 REV: E

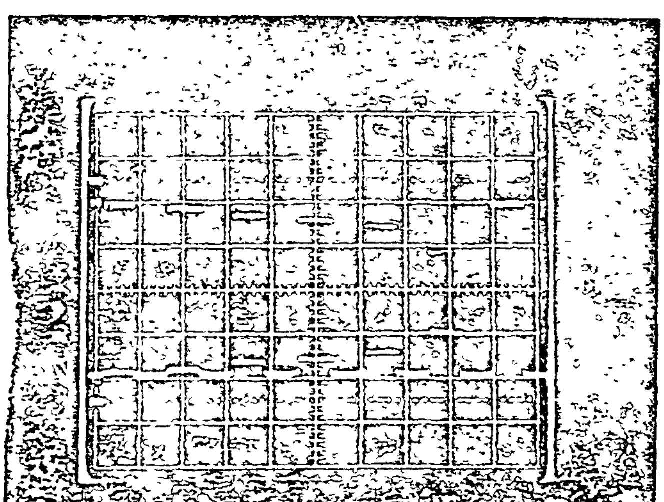
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO. ______

DATA REF. NO: ______

DATE: ~~4-29-82~~ 4-30-82 TIME: ~~16:30~~ 13:00



Z@ +0.040°

TRACES
1. Band 5 Det. 8
2. Z @ +0.040°
3.
4.

SYNC V = 5V/cm

HORIZ. TIME 0.1 sec (uncal) /cm

7 E.K. 4-28-82 (172)

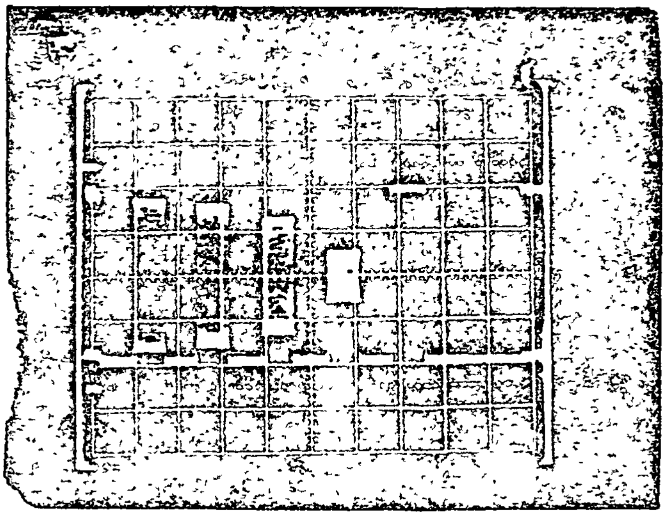
ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK: TP 32015-503 REV: G DATA STORAGE NO:

TEST TECHNIQUE: SUB-STEP 5.1.6 DATA REF. NO:

TEST DESCRIPTION: SCOPE PHOTOS DATE: ~~4-29-82~~ 4-30-82 TIME: ~~17:00~~ EK 13:10



TRACES:

1. Band 5 Det. 8

2. 3 @ -0.040°

3.

4.

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 sec (incl.)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

F-1 CROSS-TRACK (FINAL RUN) (Post-test recheck)

POLAROID PRINT DATA CARD

PROC. BK. REV: DATA STORAGE NO.

TEST TECHNIQUE. SUB-STEP DATA REF. NO.

TEST DESCRIPTION. DATE. TIME:

POLAROID PRINT
(STAPLE TO CARD FOR TRANSMITTAL)

TRACES.

1.

2.

3.

4.

SYNC.

HORIZ. TIME

ORIGINAL PAGE IS
OF POOR QUALITY

POLAROID PRINT DATA CARD

PROC. BK: TP32015-503 REV: G

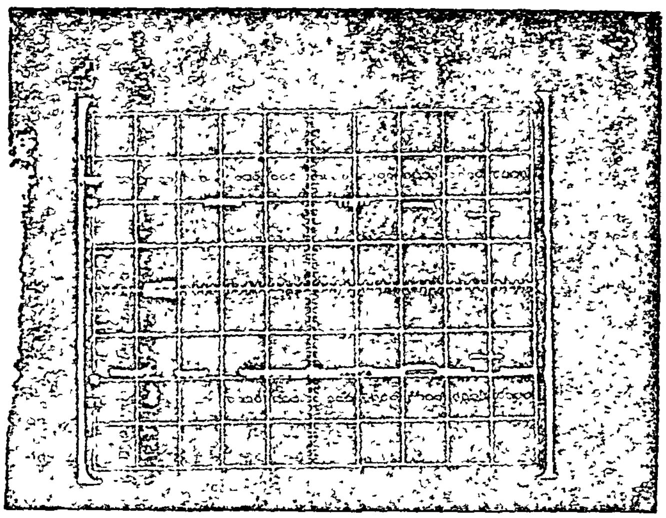
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO: ______

DATA REF. NO: ______

DATE: ~~4-29-82~~ 4-30-82 TIME: ~~16:50~~ 13:05



~~Z @ +0.080"~~

4-29-82 (16:50) Z @ +0.008"

TRACES:

1. Band 5 Det. 8

2. Z @ +0.080"

3. ______

4. ______

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 sec (meas.)/cm

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

F-1 CROSS-TRACK (FINAL RUN)
(Post-test recheck)

POLAROID PRINT DATA CARD

PROC. BK TP32015-503 REV: G

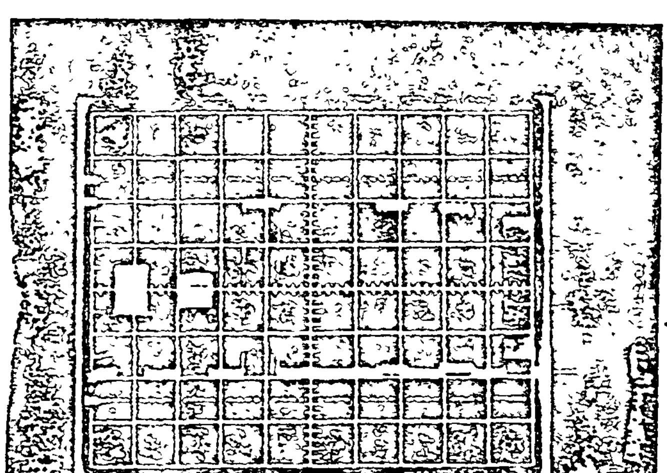
TEST TECHNIQUE: ______ SUB-STEP 5.1.6

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO. ______

DATA REF. NO. ______

DATE: ~~4-29-82~~ 4-30-82 TIME: ~~17:10~~ 13:15



TRACES.

1. Band 5 Det. 8

2. Z @ -0.080"

3. ______

4. ______

SYNC V = 5V/cm

HORIZ. TIME: 0.1 sec (meas.)/cm

3.2.3 IA04 TEST

Focus Verification, Rotational Alignment, Band-to-Band Registration

Test Summary: HS236-8026A D. Brandshaft
HS236-8033 E. Kelly

Test Specification: TP32-15-504 Cold Focal Plane Fine Focus and Band-to-Band Registration

Reference Documentation: None

NOTE. USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT
ADDENDIX A — Page 2 [illegible]

0-1007-115 HS236-8000

L. E. Long

ORIGINAL PAGE IS
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SANTA BARBARA RESEARCH CENTER

A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO: J. L. Engel

CC: TM Data Bank (2)

DATE: 28 June 1982

REF: HS236-8026 A
SED-118 A

SUBJECT: IA04R Preliminary Test Results
(With Changes in Y-DISPLACEMENT IFOV's as noted)

FROM: D. Brandshaft

BLDG. B11 MAIL STA. 40
EXT. 6343

OBJECTIVES:

1. Establish focus of cold focal plane.
2. Test inchworms and LDVT's.
3. Establish prime to cold focal plane registration.

RESULTS:

Figure 1 shows the final measurement of the cold focal plane focus. The measured MTF at focus (0.000") and at the predicted focus after dryout of the carbon epoxy telescope (-0.024") are adequate.

All three inchworm-LDVT pairs worked well.

Table 1 shows the displacements of the bands from their nominal locations. Cold to warm focal plane registration is adequate. Note, however, that bands 5 and 7 are too far apart. This anomaly is dealt with in failure report 5777.

D. Brandshaft

D. Brandshaft

DB:pg

Attachments: 2

Distribution: TM Lists B,C,H,I,J,K,U

HORIZ. TIME: 0.1 sec (cancel) /cm

NOTE. USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMME

ORIGINAL PAGE IS
OF POOR QUALITY

HS236-8026 A

Attachment

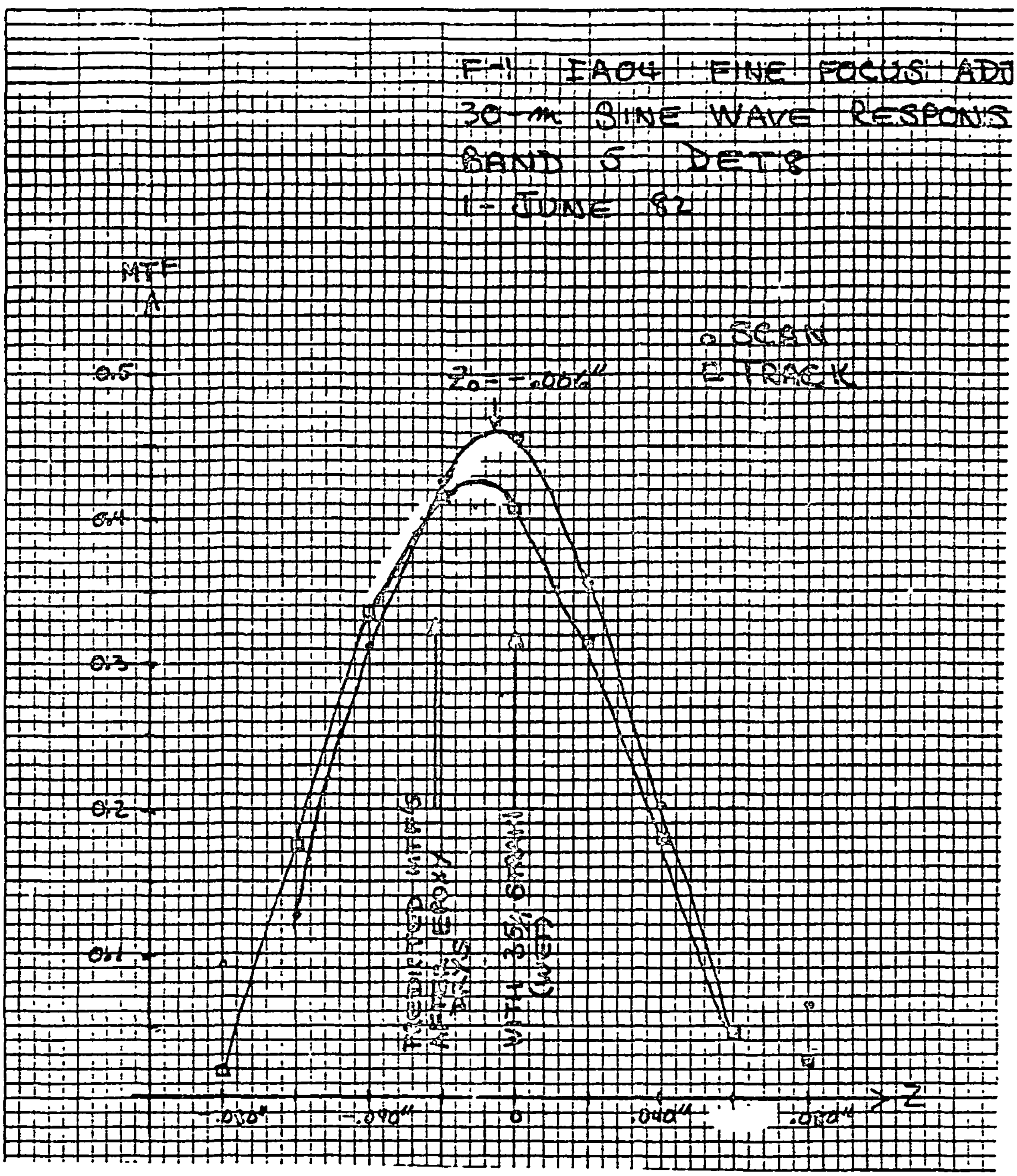

FIGURE 1

FINAL FOCUS TEST

SWNG. V · 5 v/cm

HORIZ. TIME. 0.1 sec (unc.) / cm

NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115 HS236- 8009

HS236-8026 A

Attachment 2

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OF POOR QUALITY

BAND NO.	X-DISPLACEMENT (IFOV's)	Y-DISPLACEMENT (IFOV's)
1	+.056	+.326 *
4	.000	.000
7	-.070	-.132
5	-.099	+.099 **

* This out of spec condition covered by approved Waiver W-126

** Erroneously shown as -.099 in HS236-8026

TABLE I. Displacements of Bands from Their Nominal Positions in IFOV's (X is the track direction and Y is the scan direction)

SYNC: V = 5 V/cm

HORIZ. TIME: 0.1 sec (uncal)/cm

30 T9,005

US 236-8...

NOTE USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT

APPENDIX A — Page 5 of 1

ORIGINAL PAGE IS OF POOR QUALITY

SANTA BARBARA RESEARCH CENTER

A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO: TM Distribution
Systems Test Reports

CC:

DATE: 16 June 1982

REF: HS236-8C33
SED-125

FROM: E. M. Kelly

SUBJECT: IA04 MTF/FOCUS & CFPA/PFPA BBR TEST RESULT SUMMARY, TM Flight Model

BLDG. B11 MAIL STA. 101
EXT. 6378

REFERENCES

1. TP32015-504(C), Cold Focal Plane Fine Focus and Band-to-Band Registration (IA04R).

2. History Tapes #D03020 thru D03028.

3. BTCE #2 Event Log for Period 15 May 1982 thru 21 May 1982, and 28 May 1982 thru 3 June 1982.

4. Brandshaft, D. G., "IA04R Preliminary Test Results," HS236-8026 dated 14 June 1982.

SUMMARY

This report contains the key results of the MTF/Focus and the CFPA/PFPA BBR sections of IA04R tests, performed from 15 May thru 21 May 1982, and from 28 May thru 3 June 1982, per Test Procedure TP32015-504(C).

The results of the Pre-pinning Tests (Para. 5.1.6 thru Para. 5.5.16) were used for the determination of:

1. Fine Focus of Band 5.

2. Proper Band-to-Band Registration (BBR) of CFPA to PFPA, with appropriate Radiative Cooler (RC) z-axis rotational adjustments, using the special RC Adjustment Tool Assembly (#78196).

The results of the Post-pinning Tests (Para. 5.9 thru Para. 5.12.23) were used to:

1. Verify fine focus of Band 5 was maintained after the RC drilling and pinning operation.

2. Determine whether any further inchworm (IW) adjustments need to be performed to trim the BBR in ...

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SUMMARY (continued)

3. Verify appropriate BBR has been obtained (i.e., <4 microradians).

OBJECTIVES

The initial objective was to place the CFPA within 0.002" of the cold focal plane.

The final objective was to place the CFPA within $\pm$ 0.001" of the cold focal plane; then to trim the CFPA to PFPA Band to Band Registration (BBR) in cross and along track directions (i.e., for an offset to be $\leq$ 0.00043"), by use of inchworm adjustments.

TEST CONFIGURATION DOCUMENTATION

The tests reported herein are integration-level tests performed on the Thematic Mapper (TM) Optical Assembly to establish final lateral and angular positioning of the Radiative Cooler Assembly, and to achieve optimum focusing of the CFPA (but not including Band 6).

The tests were conducted with the SMA/TM Telescope/Aft Optics Assembly/ and Radiative Cooler mounted on the TM Main Frame and oriented to align the optical axes of the TM Telescope and Collimator. The IA04R test configuration is illustrated in Figure 1-1 of the test procedure (TP32015-504C).

Fine focusing of Bands 5 and 7 was confirmed by calculating the Modulation Transfer Function (MTF) of selected detectors. These MTF data were maximized by inchworm adjustments of the spherical relay mirror.

Following the pinning of the Radiative Cooler Assembly to the Radiative Cooler Adapter and the Telescope Assembly, final CFPA to PFPA registration was achieved by additional adjustments of the three inchworms.

TEST RESULTS

This section summarizes the data which resulted from running each part of the IA04R test procedure (both the MTF/Focus and the CFPA/PFPA BBR tests). Table 1 summarizes the series of the MTF/Focus tests and their test conditions. This table lists each test by name and its paragraph in the IA04R test procedure. As noted in

TEST RESULTS (continued)

the table, "Z-axis Focus Range" and "Z-axis Steps" refer to motion of the MTF Wheel from its "Home" position at the Focal Plane of the Collimator. The "Collimator to TM Alignment" column lists the location in the TM Prime Focal Plane with which the Collimator axis is aligned during each MTF/Focus test. This alignment was adjusted by rotating the TM on its Azimuth Table.

Appendix A contains a copy of the ocilloscope photos placed in the Data Master; the tabulated MTF values may be compared with the SWR values which may be obtained from these scope traces. Tables 2 through 8 summarize the results of the remaining MTF/Focus test sequences. Figures 1 through 7 contain plots which were derived from this last group of MTF/Focus tables.

Essentially all BBR confirmation data was obtained by use of Detectors 1, 7 and 15 and Bands 1, 4, 5 and 7. Band 4, Detector 7 served as the scan-coordinates reference center.

Post-adjustment measurement data are tabulated in Tables 9 and 10, according to the direction of measurement. Figure 8 graphically displays the residual mis-registration of detector centers relative to a nominal grid.

Band 1-to-Band 4 mis-registration appears to be 0.056 IFOV in the along track direction and 0.326 IFOV in the cross track direction.

Band 4-to-Band 7 mis-registration appears to be 0.070 IFOV in the along track direction and 0.132 IFOV in the cross track direction.

Band 5-to-Band 7 mis-registration appears to be 0.029 IFOV in the along track direction and 0.231 IFOV in the cross track direction (see Reference #4).

DISCUSSION AND CONCLUSIONS

Pre-Pinning

On 15 May 1982 the initial IA04 Coarse Focus (IA4CFF.DSL) test was run, after emergency updating the (IA4CFF) command files for Detector 8 in Band 5; Detector 9 was not reliably operative at this time. Peak Modulations were:

Cross Track = +0.005"

Along Track = -0.014"

On 17 May 1982 we repeated the IA04 Coarse Focus (IA4CFF.DSL) test, for verification of the above initial test. When it was noticed that this run practically matched the initial run, the Systems/ Optics Analyst decided that he had sufficient MTF focus data to

DISCUSSION AND CONCLUSIONS

Pre-Pinning (Continued)

determine the magnitude and direction of any spherical relay mirror movement required. Peak Modulations were:

Cross Track = +0.004"

Along Track = -0.012"

The BBR portion of IA04 test procedure was started on 18 May 1982; this was the Cold Focal Plane to Prime Focal Plane Registration (Para.5.5 of TP32015-504C). Inchworms were stepped as follows:

(a) I.W. #1 extended 10 steps (≃-0.005" in "x" direction)
    I.W. #1 contracted 33 steps(≃+0.012" in "x")
(b) I.W. #2 contracted 5 steps(≃-0.003" in "x")
    I.W. #2 extended 23 steps (≃+0.016" in "x")
(c) I.W. #1 extended 46 steps (≃-0.025" in "x")
(d) I.W. #2 contracted 27 steps(≃-0.016" in "x")
(e) I.W. #3 extended 10 steps (≃+0.0010")
    I.W. #3 contracted 10 steps(≃+0.0004")

then (f) I.W. #2 was contracted so that the x-position 1/2 power point for Band 5 Detector 7 was near -.1325" in "x" direction (same as for Band 4 and Band 1, Detector 7).

Then the Hx and Hy collects were performed successfully, confirming that no additional rotation of Radiative Cooler was required.

The final(BBR)Hy collects were completed on 20 May 1982.

Note: Radiative Cooler and Adapter reinstalled onto Mapper 24 May 1982. Specific Pre-Pinning(Initial I.W.Move) focus test results are shown in Tables 2 and 3.

Post-Pinning

On 28 May 1982 we ran the IA04 Coarse Focus (IA4CFF.DSL) test, in lieu of Band 5 Fine Focus Test of Para. 5.9, since the IA04 Coarse Focus test has proven so reliable. Peak Modulations were:

Cross Track = +0.011"

Along Track = 0.000"

DISCUSSION AND CONCLUSIONS

Post-Pinning (Continued)

On 29 May 1982 we fine tuned the CFPA focus by moving all three (3) Inchworms, one at a time. In all, we moved:

I.W. #1 60 extend steps

I.W. #2 31 extend steps

I.W. #3 40 extend steps

Specific Post-Pinning (2nd I.W.Move) focus test results are shown in Table 4.

To verify the above fine focus adjustments, we ran another IA04 Coarse Focus (IA4CFF.DSL) test on 29 May 1982. Peak Modulations were:

Cross Track = +0.004"

Along Track = -0.010"

Also on 29 May 1982 we ran an IA01 Coarse Focus (IA1CFF.DSL) test, for peak MTF comparison of Band 4 Detector 9 versus Band 5 Detector 8, and versus previous IA01 tests. Peak Modulation was:

Cross Track = +0.016"

Note: This peak MTF differed considerably with that of the previous IA01 test results of +0.004" (taken back on 9 April 1982).

Also see 1 June 1982 data entered below and on Page 6 of this document.

On 1 June 1982 we ran another IA04 Coarse Focus (IA4CFF.DSL) test to verify 29 May runs. Peak Modulations were:

Cross Track = -0.006"

Along Track = -0.010"

These MTF peaks agreed favorably with those anticipated by the Inchworm movements, compensating for the microstrain of the Thematic Mapper carbon epoxy at dryout.

Also on 1 June 1982 we again ran an IA01 Coarse Focus (IA1CFF.DSL) test for peak MTF comparison of Band 4 Detector 9 versus Band 5 Detector 8, and versus previous IA01 tests. Peak Modulation was:

Cross Track = +0.006"

This MTF peak nearly agreed with the peak MTF's from IA01 Post-Shim

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DISCUSSION AND CONCLUSIONS

Post-Pinning (Continued)

tests, where the Peak Modulations were:

Cross Track = +0.007" (Band 2 Det. 9)

Cross Track = +0.007" (Band 3 Det. 9)

Cross Track = +0.004" (Band 4 Det. 9)

On 3 June 1982 Appendix K (Inchworm Operation) was successfully performed:

Contracted I.W. #3 one step ("y" direction)

Then final Hx and Hy collects were performed successfully.

Specific final Post-Pinning focus test results are shown in Tables 5 through 8.

Edward M. Kelly
E. M. Kelly
Test Director

D. G. Brandshaft
D. G. Brandshaft
Systems Engineer/Optics Analyst

Approved by:
G. S. Plews, Manager
Systems Integration & Test

Release Approval: J. L. Engel
J. L. Engel, Manager
Systems Engineering Dept.

EMK:pg

Attachments: 23 + Distribution for IA04

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HS236-8033

16 June 1982
Attachment 1

TABLE 1

SUMMARY OF IA04 MTF/FOCUS TESTS

TP PARA.	TEST NAME	1982 DATE	B/D USED	Z-AXIS STEPS	Z-AXIS FOCUS RANGE	COLL. to TM ALIGNMENT
PRE-RC PINNING:						
5.1.6	"SCOPE PHOTOS"	5/15	5/8	-	±0.040"	ON-AXIS
	"SCOPE PHOTOS"	5/15	5/8	-	±0.080"	ON-AXIS
5.1.7	CF(CT,AT)	5/15	5/8	.020"	±0.080"	ON-AXIS
5.1.7	CF(CT,AT)	5/17	5/8	.020"	±0.080"	ON-AXIS
POST-RC PINNING:						
5.9	CF(CT,AT)	5/28	5/8	.020"	±0.080"	ON-AXIS
I. W. FOCUS MOVE: (5/29/82)						
5.10	MOVED I.W. #1	60 EXTEND STEPS				
	" I.W. #2	31 " "				
	" I.W. #3	40 " "				
POST- I.W. MOVE:						
5.11	CF(CT,AT)	5/29	5/8	.020"	±0.080"	ON-AXIS
	*CF(CT)	5/29	4/9	.010"	±0.040"	ON-AXIS
5.11	CF(CT,AT)	6/1	5/8	.020"	±0.080"	ON-AXIS
	*CF(CT)	6/1	4/9	.010"	±0.040"	ON-AXIS

*NOTE: Above Band 4 Detector 9 tests were run for comparison only

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HS236-8033

16 June 1982
Attachment 2

TABLE 2

INITIAL PRE-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 5 DETECTOR 8)

Z-POSITION	CT MTF	AT MTF
+.080"	.0190	.0478
+.060"	.1403	.0816
+.040"	.3016	.1884
+.020"	.4231	.2970
.000"	.4655	.3891
-.020"	.3752	.4124
-.040"	.1840	.3564
-.060"	.0555	.2168
-.080"	.1572	.0853

DATA COLLECTION: DATE/TIME: 15 May 1982/15:20 &
16:20

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16 June 1982
Attachment 3

TABLE 3

FINAL PRE-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 5 DETECTOR 8)

Z-POSITION	CT MTF	AT MTF
+.080"	.0136	.0840
+.060"	.1118	.08[illegible]3
+.040"	.2672	.1900
+.020"	.4196	.3118
.000"	.4770	.4009
-.020"	.3982	.4148
-.040"	.2328	.3431
-.060"	.0501	.2006
-.080"	.1437	.0934

DATA COLLECTION: DATE/TIME: 17 May 1982/10:30 &
11:30

4-29-82 (17:40) Z @ -0.008" NOTE. USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

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16 June 1982
Attachment 4

TABLE 4

INITIAL POST-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 5 DETECTOR 8)

Z-POSITION	CT MTF	AT MTF
+.080"	.0533	.0129
+.060"	.1850	.1144
+.040"	.3414	.2285
+.020"	.4404	.3490
.000"	.4383	.4204
-.020"	.3094	.3653
-.040"	.1283	.2547
-.060"	.0792	.0931
-.080"	.1744	.0478

DATA COLLECTION: DATE/TIME: 28 May 1982/16:00 & 17:00

NOTE: This Post Pinning test was done after the second I.W. Movements.

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16 June 1982
Attachment 5

TABLE 5

2ND POST-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 5 DETECTOR 8)

Z-POSITION	CT MTF	AT MTF
+.080"	.0484	.0317
+.060"	.0971	.0702
+.040"	.2469	.1973
+.020"	.3952	.3316
.000"	.4643	.4093
-.020"	.4026	.4118
-.040"	.2642	.3242
-.060"	.0898	.1605
-.080"	.1191	.0230

DATA COLLECTION: DATE/TIME: 29 May 1982/
15:40 & 18:00

NOTE: This Post-Pinning test was the first one done after the Inchworms were moved to fine tune the CFPA focus.

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Attachment 6

TABLE 6

3RD POST-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z-POSITION	CT MTF
+.040"	.3131
+.030"	.3990
+.020"	.4380
+.010"	.4564
.000"	.4329
-.010"	.4071
-.020"	.3152
-.030"	.2264
-.040"	.1535

DATA COLLECTION: DATE/TIME: 29 May 1982/16:15

NOTE: Above test was for peak MTF comparison only.

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16 June 1982
Attachment 7

TABLE 7

4TH POST-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 5   DETECTOR 8)

Z-AXIS	CT MTF	AT MTF
+.080"	.0655	.0275
+.060"	.0493	.0450
+.040"	.2031	.1586
+.020"	.3590	.3145
.000"	.4543	.4079
-.020"	.4262	.4161
-.040"	.3133	.3373
-.060"	.1272	.1758
-.080"	.0924	.0194

DATA COLLECTION: DATE/TIME: 1 June 1982/
14:35 & 16:35

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TABLE 8

5TH POST-PINNING COARSE FOCUS TEST RESULTS

(30 METER BAR PATTERN)

(BAND 4 DETECTOR 9)

Z-AXIS	CT MTF
+.040"	.2730
+.030"	.3494
+.020"	.4193
+.010"	.4485
.000"	.4475
-.010"	.4204
-.020"	.3742
-.030"	.2706
-.040"	.1807

DATA COLLECTION: DATE/TIME: 1 June 1982/13:40

NOTE: Above test was for Peak MTF comparison only.

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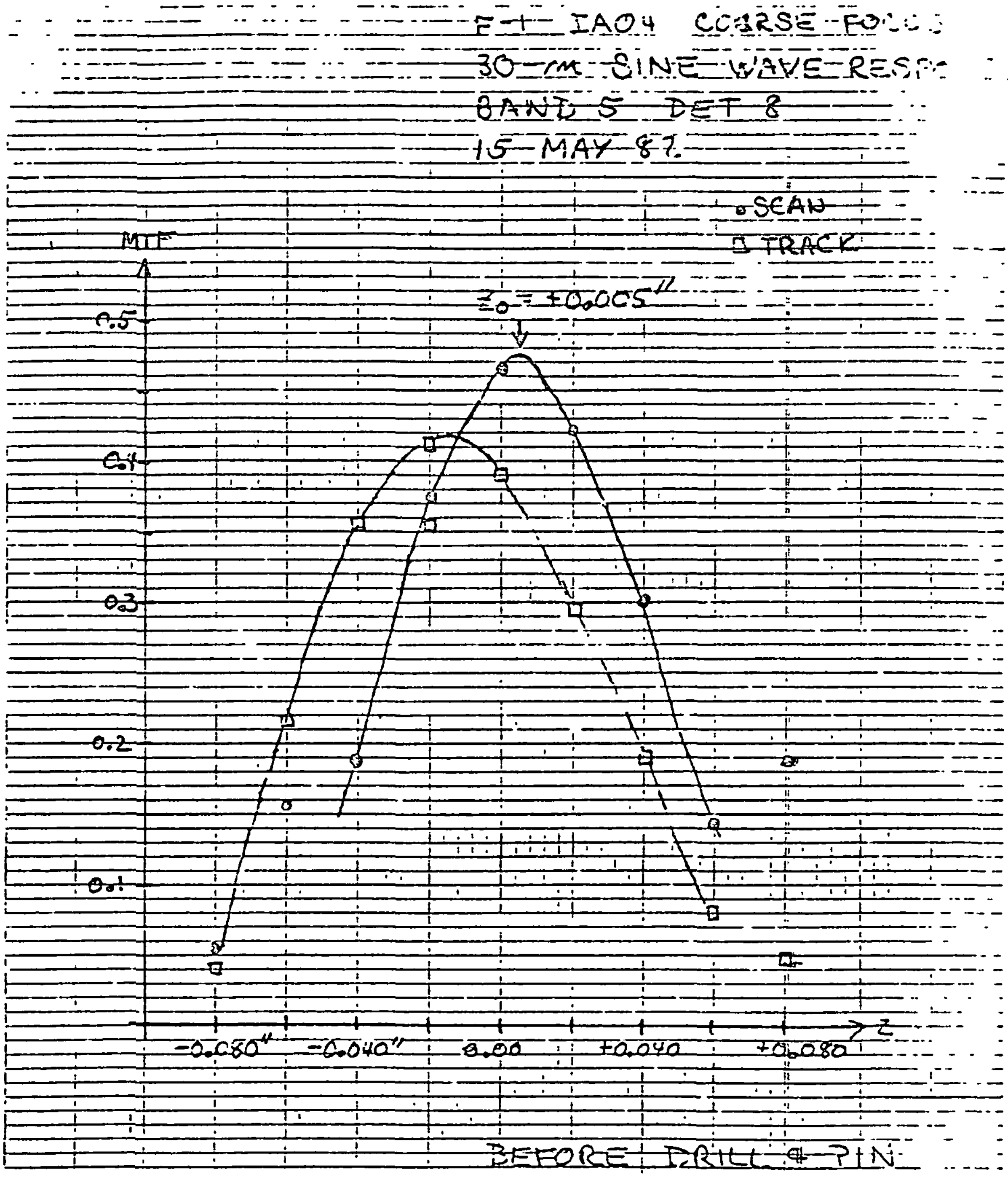
Attachment 9



46 0863

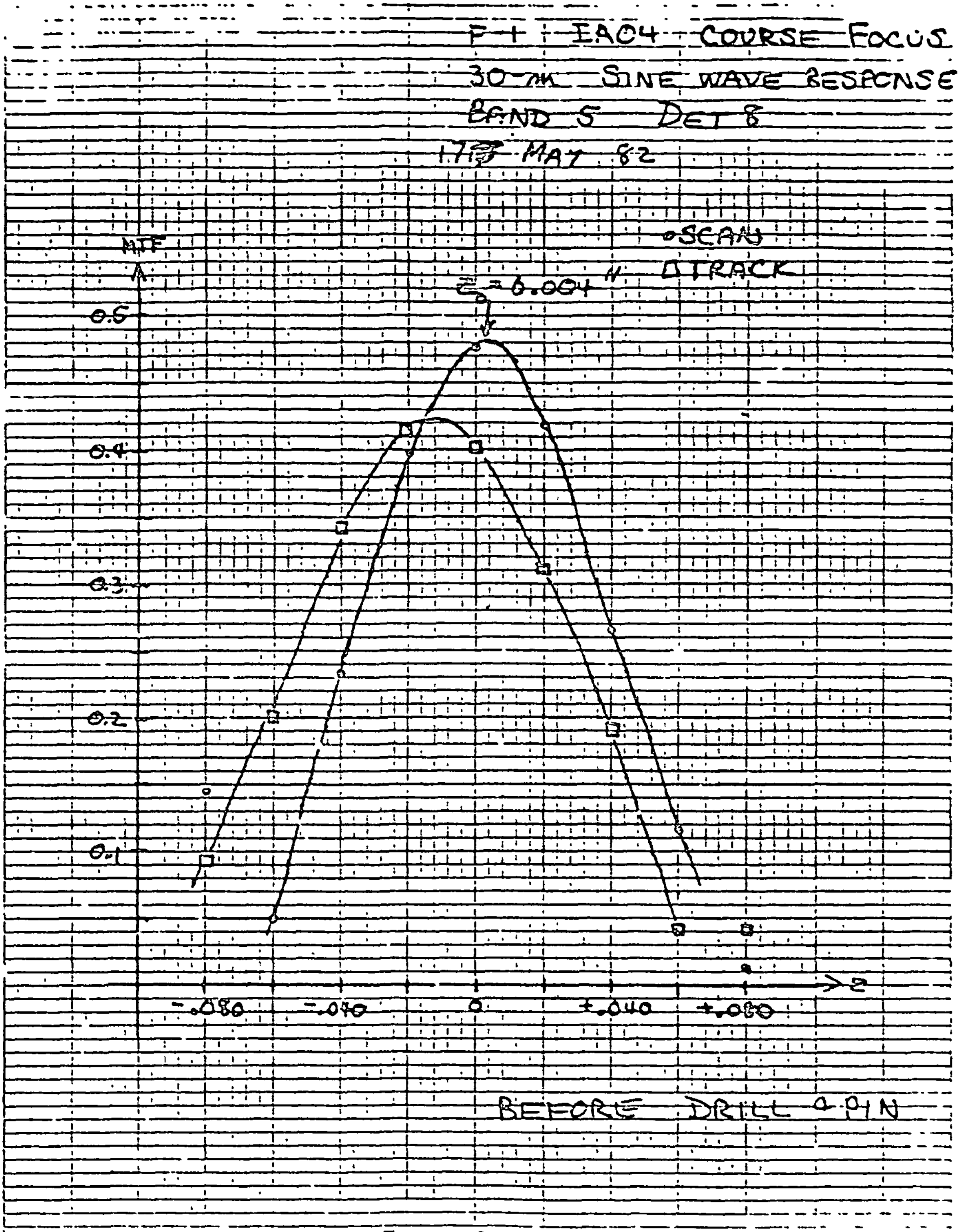

F-1 IAC4 COURSE FOCUS
30 ~~m~~ SINE WAVE RESPONSE
BAND 5 DET 8
17 MAY 82
MTF
○ SCAN
□ TRACK
Z = 0.004"
0.5
0.4
0.3
0.2
0.1
-.080
-.040
0
+.040
+.080
Z
BEFORE DRILL & PIN

FIGURE 2

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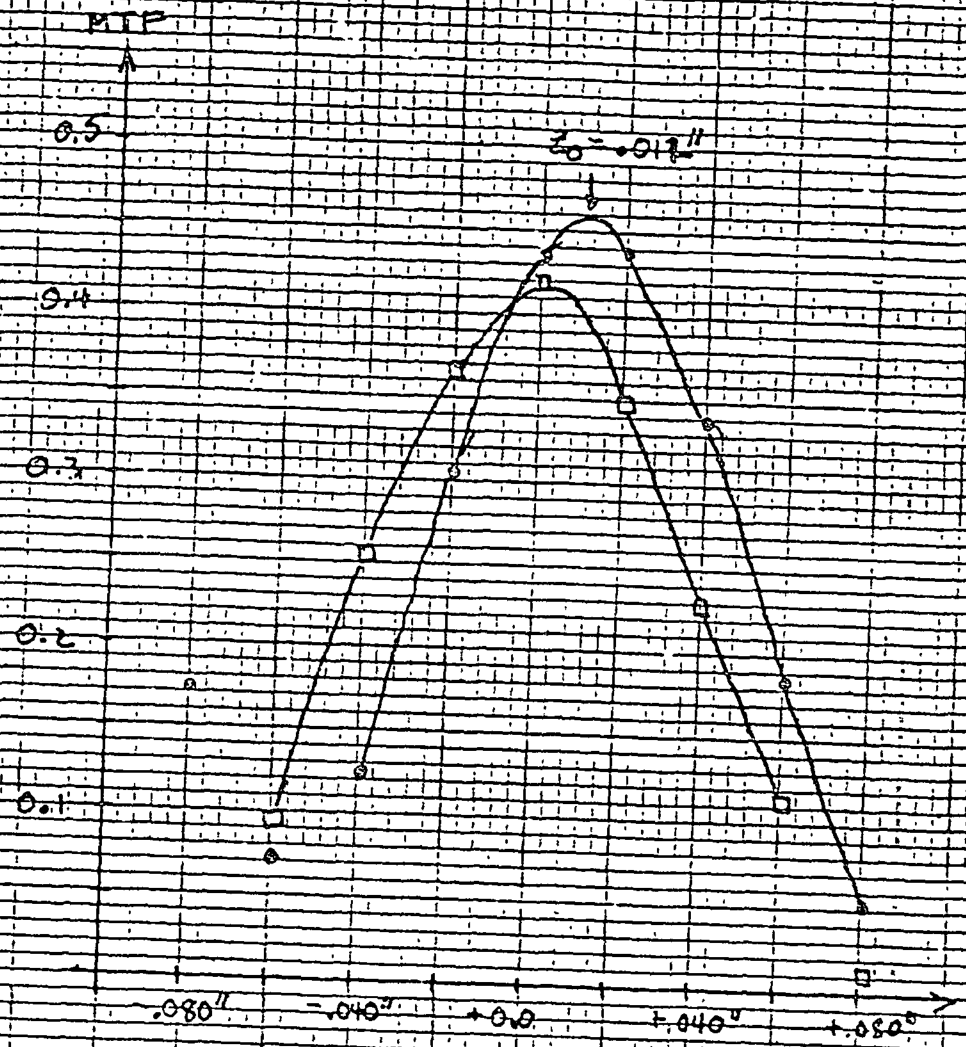
F-1 IAC4 COARSE FOCUS
30m SINE WAVE RESPONSE
BAND 5 DET 8
28-MAY-82



FIRST RUN AFTER DRILL
& PIN OF RAD COOLER

FIGURE 3

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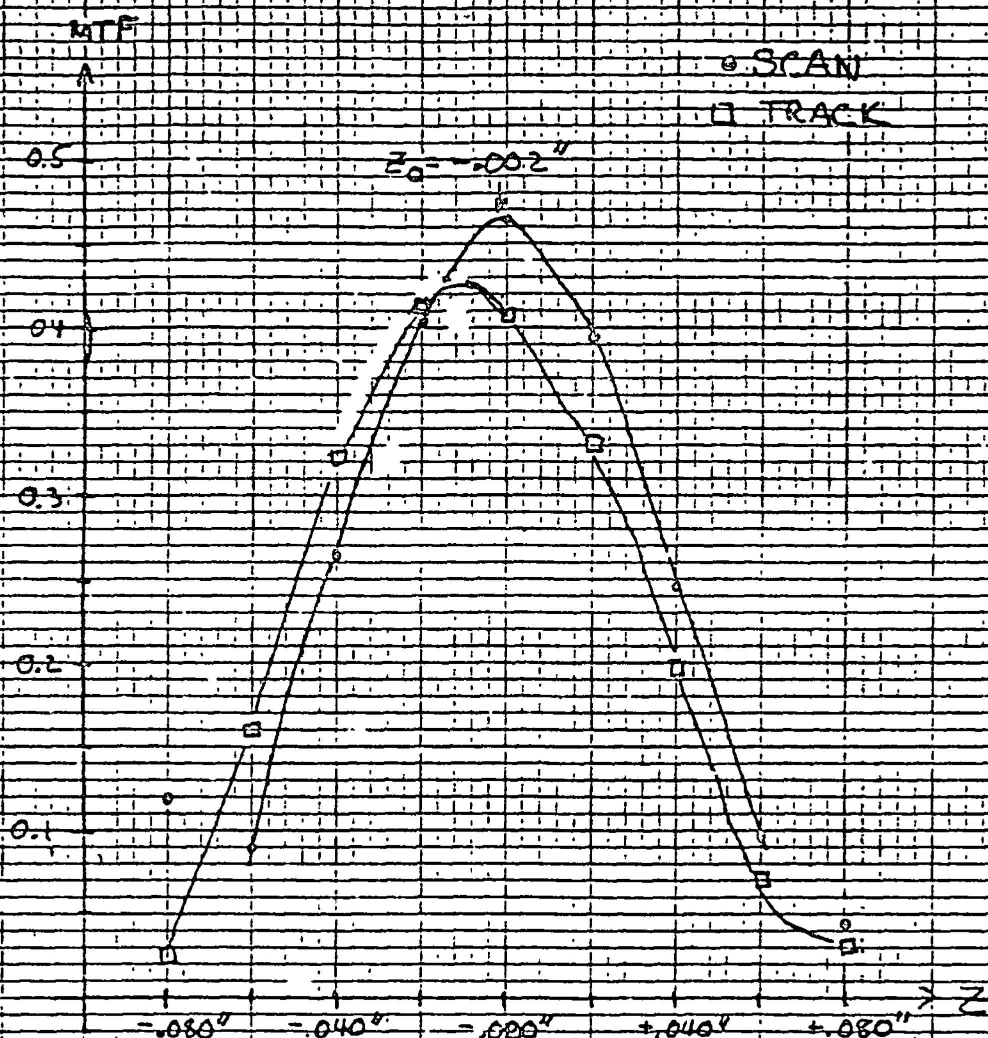
Attachment 12

F-1 IA04 FINE FOCUS ADJUST
30-m SINE WAVE RESPONSE
BAND 5 DET 8
27 MAY 82



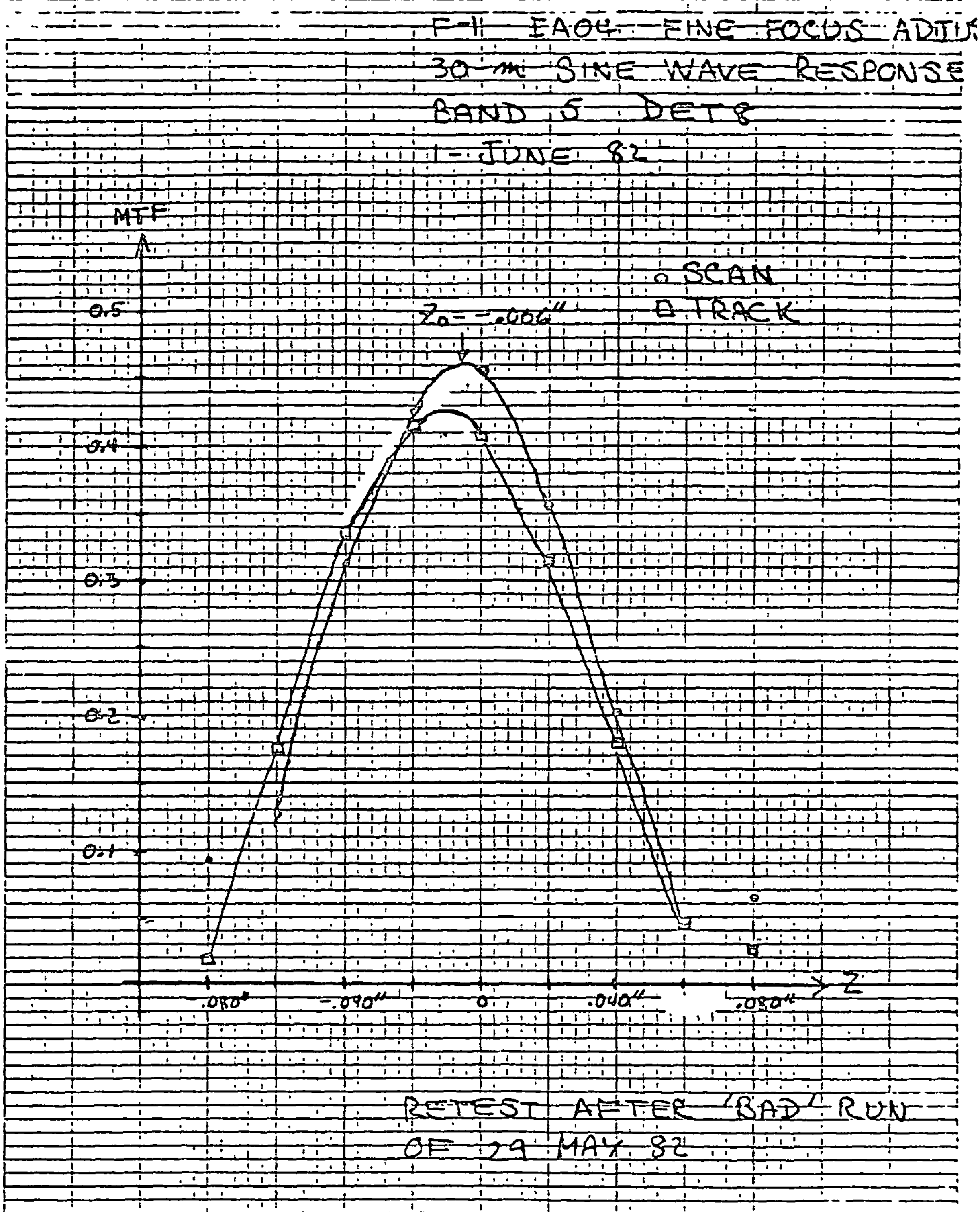
AFTER FOCUS ADJUST

ADD +.006" TO SCAN Z VALUES
(HOME WAS REALLY AT -.006")

FIGURE 4

46 0863

K-E 5 X 5 TO 1/2 INCH • 7 X 10 INCHES KEUFFEL & ESSER CO.



F-1 EA04 FINE FOCUS ADJU
30 m SINE WAVE RESPONSE
BAND 5 DET 8
1-JUNE 82
MTF
0.5
0.4
0.3
0.2
0.1
o SCAN
□ TRACK
Z₀ = -.006"
-.080"
-.040"
0
.040"
.080"
Z
RETEST AFTER 'BAD' RUN
OF 29 MAY 82

FIGURE 5

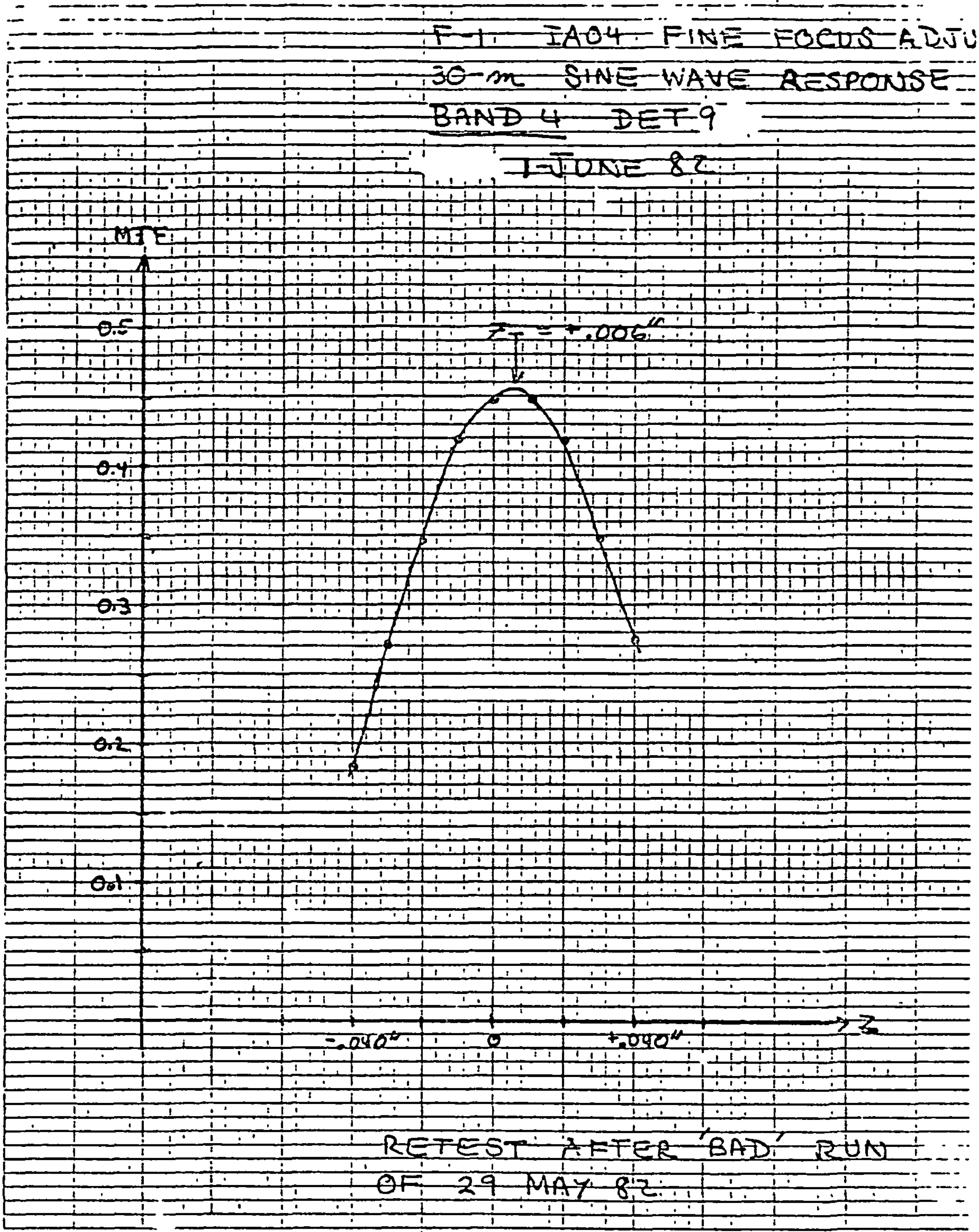

F-1 IA04 FINE FOCUS ADJU
30 m SINE WAVE RESPONSE
BAND 4 DET 9
1 JUNE 82
MTF
0.5
0.4
0.3
0.2
0.1
F = +.006"
-.040"
0
+.040"
Z
RETEST AFTER 'BAD' RUN
OF 29 MAY 82

FIGURE 6

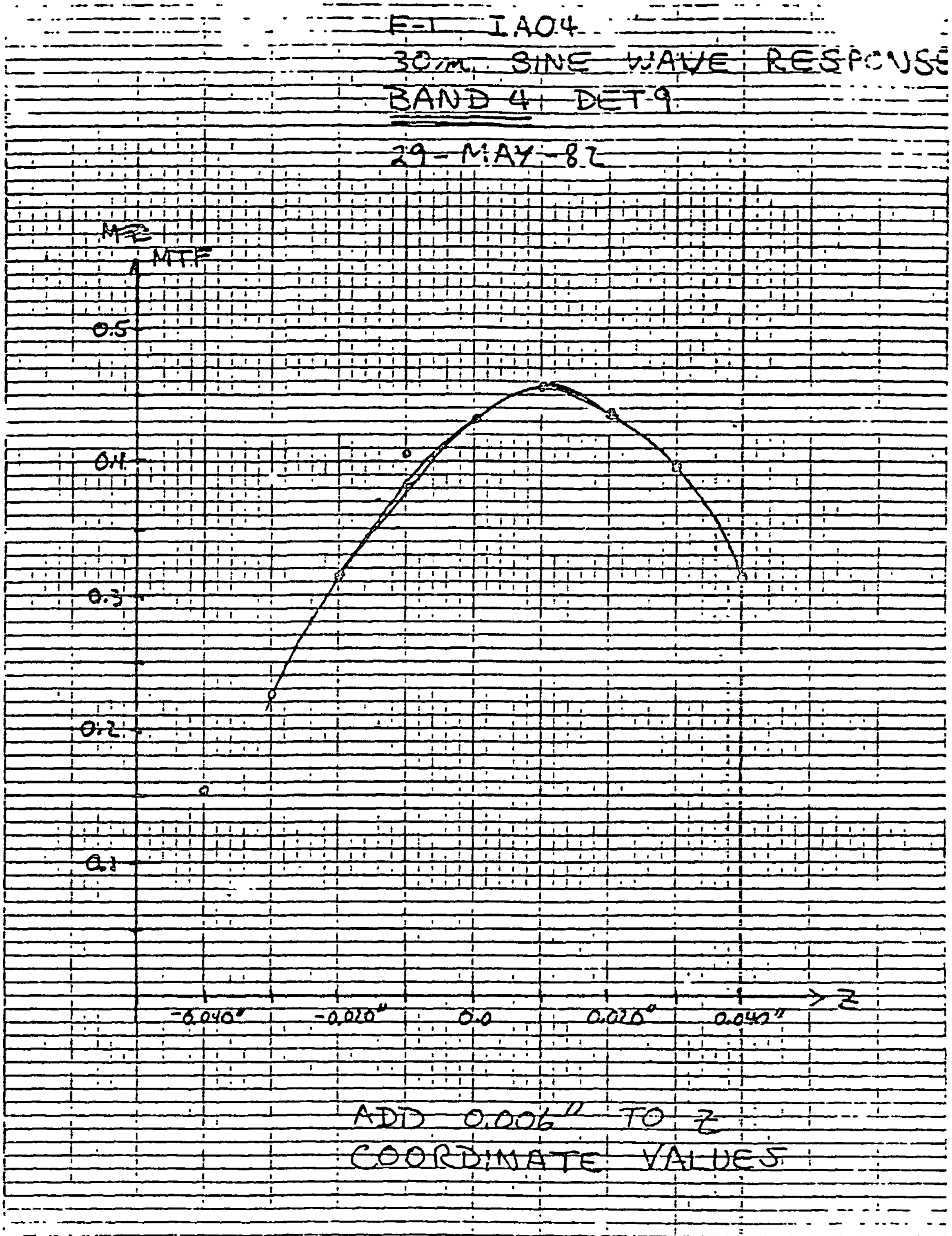

F-I IA04
30m. SINE WAVE RESPONSE
BAND 4 DET 9
29-MAY-82
MTF
0.5
0.4
0.3
0.2
0.1
-0.040"
-0.020"
0.0
0.020"
0.040"
Z
ADD 0.006" TO Z
COORDINATE VALUES

FIGURE 7

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Attachment 1

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______

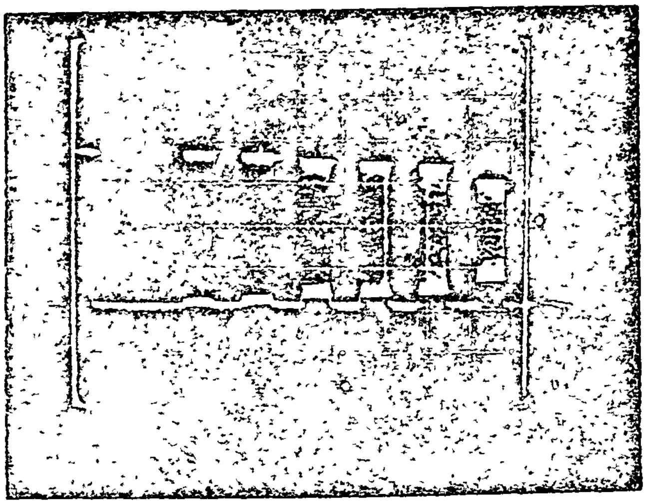
TEST TECHNIQUE: TP32015-504 SUB-STEP c

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO: ______

DATA REF. NO: ______

DATE: 5-15-82 TIME: 14:30



TRACES:

1. Band 5 Det 8
   Z @ Home (.0000")
2. CROSS-TRACK
3.
4.

SYNC: V = 5V/cm

HORIZ. TIME: ______

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENT

0-1007-115

F-1 - IAΦ4 - (CROSS TRACK)

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______

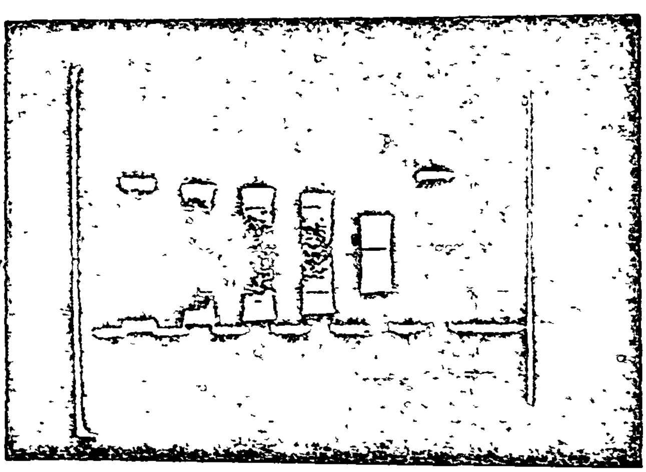
TEST TECHNIQUE: TP32015-504 SUB-STEP C

TEST DESCRIPTION: ______

DATA STORAGE NO: ______

DATA REF. NO: ______

DATE: 5-15-82 TIME: 14:35



TRACES:

1. Band 5 Det 8
   Z @ +0.040"
2.
3.
4.

SYNC: V = 5V/cm

HORIZ. TIME: ______

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Attachment 17

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______

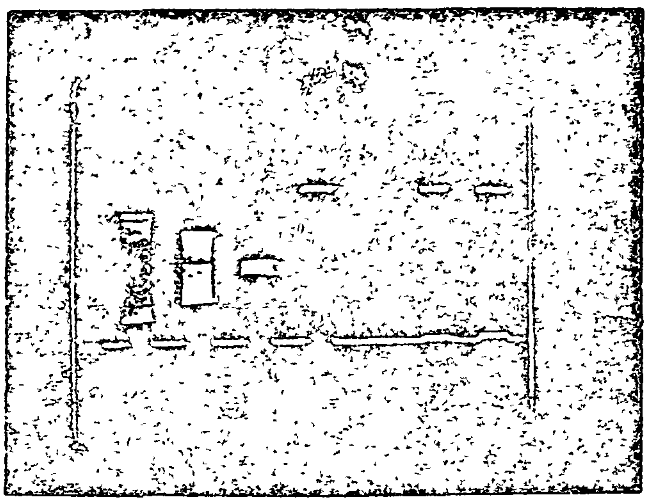
TEST TECHNIQUE: TP32015-504 SUB-STEP C

TEST DESCRIPTION: SCOPE PHOTOS

DATA STORAGE NO: ______

DATA REF. NO: ______

DATE: 5-15-82 TIME: 14:45



TRACES.

1. Band 5 Det 8
Z @ +0.080°

2. ______

3. ______

4. ______

SYNC: V - 5 v/cm

HORIZ. TIME. ______

NOTE: · USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-116

F-1 IA04 (CROSS TRACK)

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______

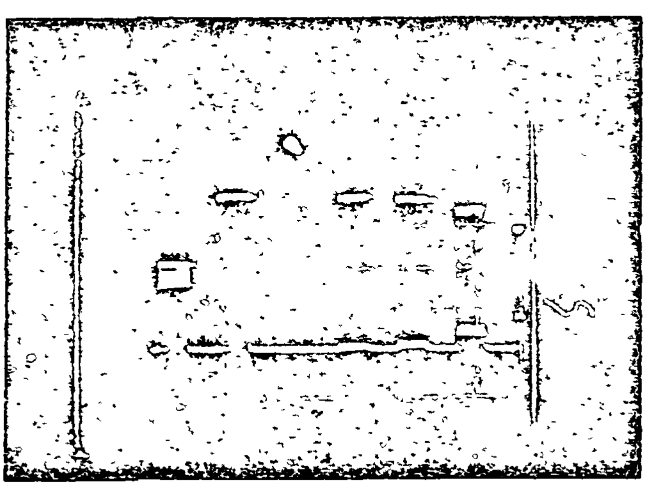
TEST TECHNIQUE: TP32015-504 SUB-STEP C

TEST DESCRIPTION: ______

DATA STORAGE NO: ______

DATA REF. NO: ______

DATE. 5-15-82 TIME: 1455



TRACES:

1. Band 5 Det 8
Z @ - 0.080°

2. ______

3. ______

4. ______

SYNC: V - 5 v/cm

HORIZ. TIME. ______

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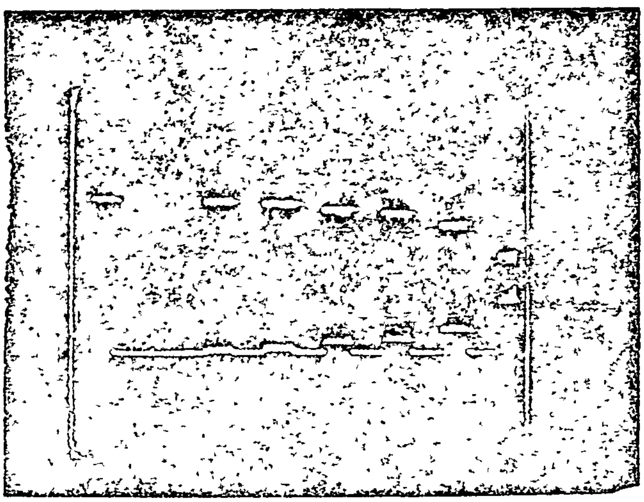
Attachment 1

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______ DATA STORAGE NO: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP e DATA REF. NO: ______

TEST DESCRIPTION: SCOPE PHOTOS DATE: 5-15-82 TIME: 14:50



TRACES:

1. Band 5 Det 8
   Z @ -0.040°
2. CROSS-TRACK
3.
4.

SYNC: V = 5 V/cm

HORIZ. TIME: 1 sec small.

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMEN

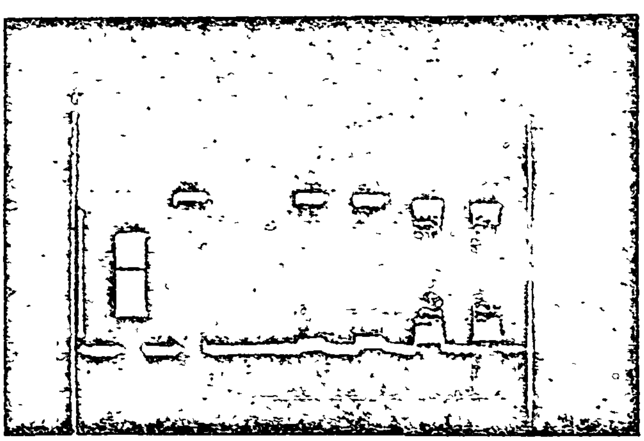
0-1007-115

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______ DATA STORAGE NO: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP e DATA REF. NO: ______

TEST DESCRIPTION: SCOPE PHOTOS DATE: 5-15-82 TIME: 16:25



TRACES:

1. Band 5 Det 8
   Z @ -0.040°
2. ALONG TRACK
3.
4.

SYNC. V = 5 V/cm

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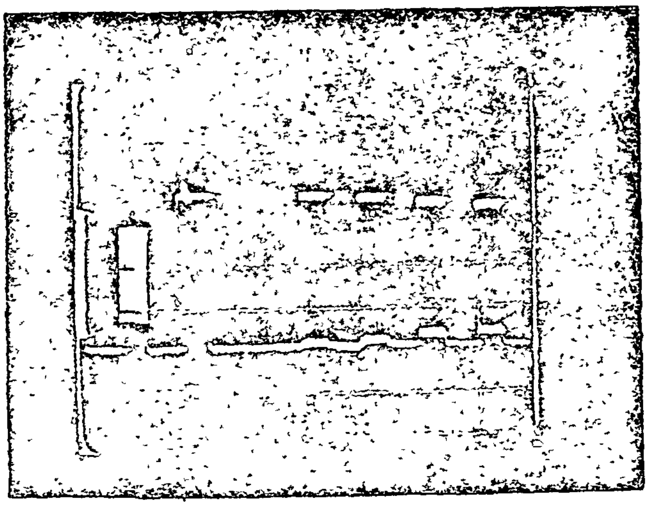
Attachment 19

POLAROID PRINT DATA CARD

PROC. BK.: ______ REV.: ______ DATA STORAGE NO.: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP c DATA REF. NO.: ______

TEST DESCRIPTION: SCOPE PHOTOS DATE: 5-15-82 TIME: 16'10



TRACES:

1. Band 5 Det 8
   Z @ HOME (+0.018°)
2. dial = 797
   (only HTT wheel offset, but c.c.
   & ALONG TRACK
3.
4.

SYNC. H = 5V/cm

HORIZ. TIME: 0.1 sec. [illegible]

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

0-1007-115

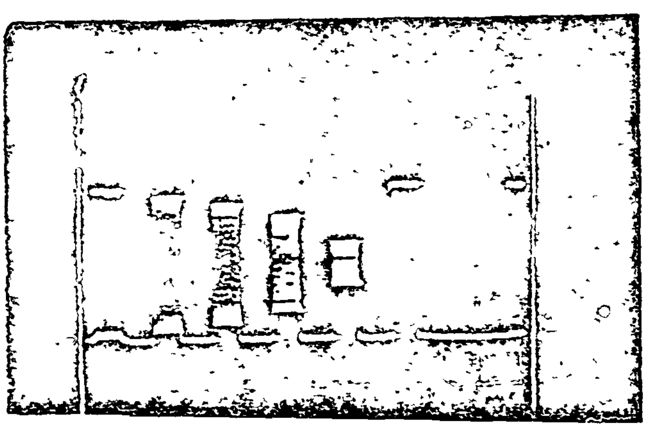
F1 IAØ4 (ALONG TRACK)

POLAROID PRINT DATA CARD

PROC. BK.: ______ REV.: ______ DATA STORAGE NO.: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP c DATA REF. NO.: ______

TEST DESCRIPTION: ______ DATE: 5-15-82 TIME: 16'15



TRACES:

1. Band 5 Det 8
   Z @ +0.040"
2.
3.
4.

SYNC. H = 5V/cm

HS236-8033

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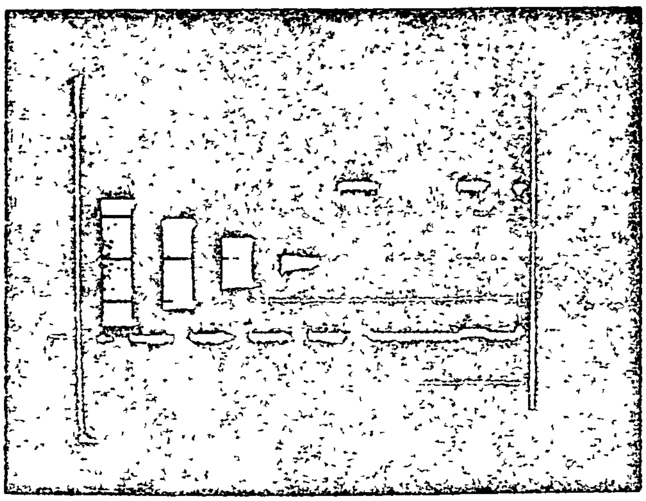
16 June 1982
Attachment 20

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______ DATA STORAGE NO: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP C DATA REF. NO: ______

TEST DESCRIPTION: Scope Photo DATE 5-15-82 TIME: 16:20



TRACES:

1. Band 5 Det 8
   Z @ +0.080°
2.
3.
4.

SYNC: V = 5V/cm

HORIZ. TIME: 0.1 sec uncal.

0-1007-116

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMMENTS

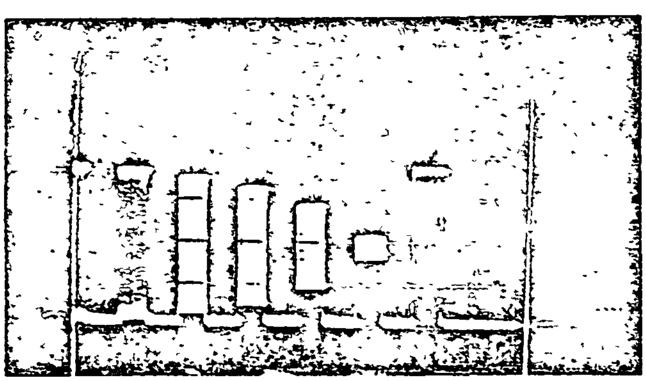
F-1 IAØ4 (ALONG TRACK)

POLAROID PRINT DATA CARD

PROC. BK: ______ REV: ______ DATA STORAGE NO: ______

TEST TECHNIQUE: TP32015-504 SUB-STEP C DATA REF. NO: ______

TEST DESCRIPTION: ______ DATE: 5-15-82 TIME: 16:30



TRACES:

1. Band 5 Det 8
   Z @ -0.080°
2.
3.
4.

TM FLIGHT MODEL - IA04 TEST RESULT SUMMARY: CFPA/PFPA BBR STATUS

X-DIRECTION (ALONG TRACK)

IA04 POST SHIM DATA OF 3 JUNE 1982

Band	Detector	Measured Detector Center from Band 4 Det. 7 (PFPA inches)	*Nominal Center from Band 4 Det.7 (PFPA inches)	Measured Center Displacement (PFPA inches)
1	1	0.024364	0.032640	-0.008276
1	7	-0.000146	0.008160	-0.008306
1	15	-0.032796	-0.024480	-0.008316
4	1	0.024546	0.032640	-0.008094
4	7	0.000000	0.000000	0.000000
4	15	-0.032659	-0.024480	-0.008179
5	1	0.025088	0.032640	-0.007552
5	7	0.000779	0.008160	-0.007381
5	15	-0.031585	-0.024480	-0.007105
7	1	0.025128	0.032640	-0.007512
7	7	0.000840	0.008160	-0.007320
7	15	-0.031530	-0.024480	-0.007050

ES: 1. Measured Center Displacements are from nominal center values, relative to the Reference Detector (Band 4 Det.7) location.
2. *Nominal Center includes (2) IFOV offset (+.00816")due to using Band 4 Det.9 data base for Band 4 Det.7.
3. Reference Detector Offset = 0.008031 in PFPA inches.
4. Above data taken from COVEST.RED;5 data printout.

TABLE 9

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16 June 1982
Attachment 22

TM FLIGHT MODEL - IA04 TEST RESULT SUMMARY: CFPA/PFPA BBR STATUS

Y-DIRECTION (ALONG SCAN)

IA04 POST SHIM DATA OF 3 JUNE 1982

Detector	Measured Detector Center from Band 4 Det. 7 (PFPA inches)	Nominal Center from Band 4 Det. 7 (PFPA inches)	Measured Center Displacement (PFPA inches)
1	0.307390	0.306000	0.001390
7	0.307422	0.306000	0.001422
15	0.307468	0.306000	0.001468
1	0.000135	0.000000	0.000135
7	0.000000	0.000000	0.000000
15	0.000156	0.000000	0.000156
1	-0.289076	-0.289680	0.000604
7	-0.289136	-0.289680	0.000544
15	-0.289320	-0.289680	0.000360
1	-0.183910	-0.183600	-0.000310
7	-0.184006	-0.183600	-0.000406
15	-0.184210	-0.183600	-0.000610

1. Measured Center displacements are from nominal center values, relative to the Reference Detector (Band 4 Det.7) location.
2. Reference Detector Offset = -0.000309 in PFPA inches.
3. Above data taken from COVEST.RED;12 data printout.

TABLE 10

FIGURE 1

HS236-8033

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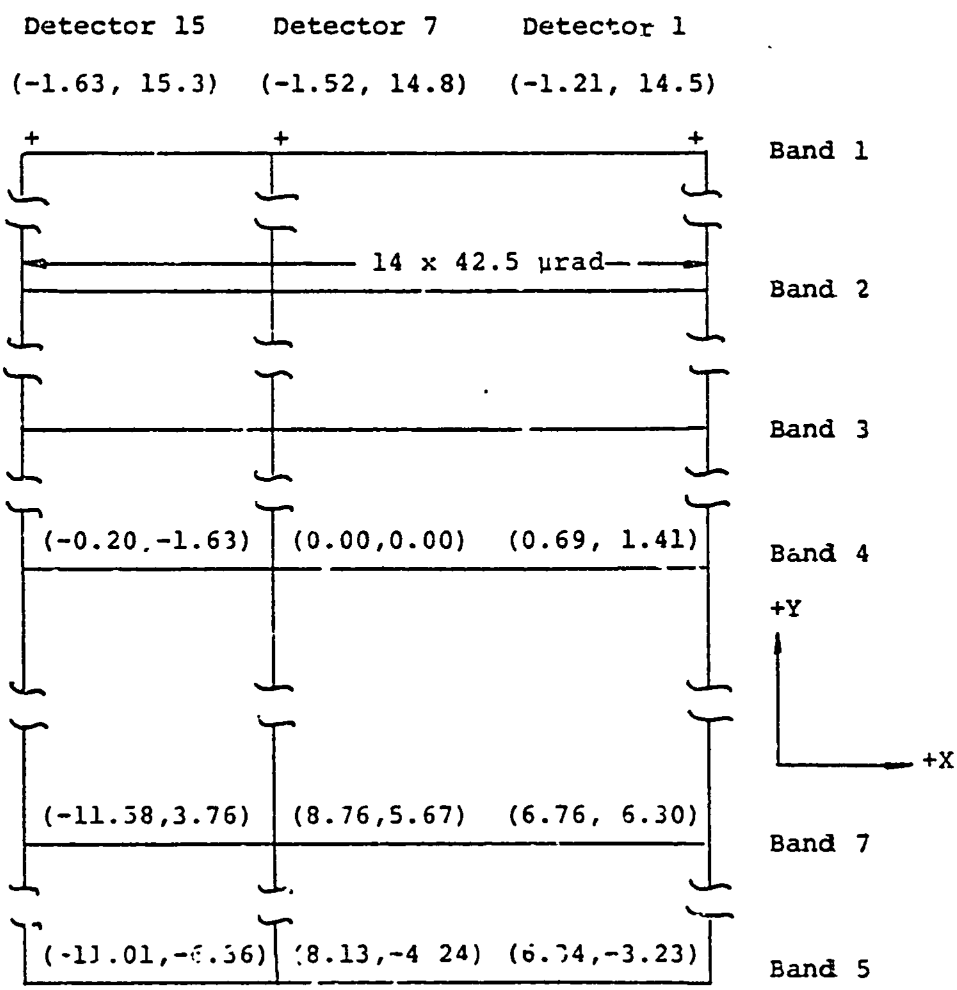
16 June 1982
Attachment 23

TM FLIGHT MODEL TEST RESULT SUMMARY

CFPA/PFPA BBR STATUS

BBR STATUS IA04R POST SHIM
DATA OF 3 JUNE 1982



Notes: (a) Coordinates are deviations from IDEAL Channel Center locations, relative to B4,D7, and normalized for (2) IFOV delta of Table 9.

SANTA BARBARA RESEARCH CENTER
A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO: G. Plews

CC: J. Campbell, R. Dick, E. Kelly, F. Nicholas, T. Sciacca, D. Young, Data Bank (6)

DATE: 27 May 1982

REF: HS236-8005
2221-600

FROM: W. J. O'Donnell

BLDG. B11 MAIL STA 78

EXT 6373

SUBJECT: IA03R Coarse Focus Determination, Cold Focal Plane

The Thematic Mapper cold focal plane best focus position was found to be .289 + ΔZ from the collimator best focus (long focus), or a .0558 + ΔZ at the T/M cold focal plane (short focus). This dimension was determined by the following formula:

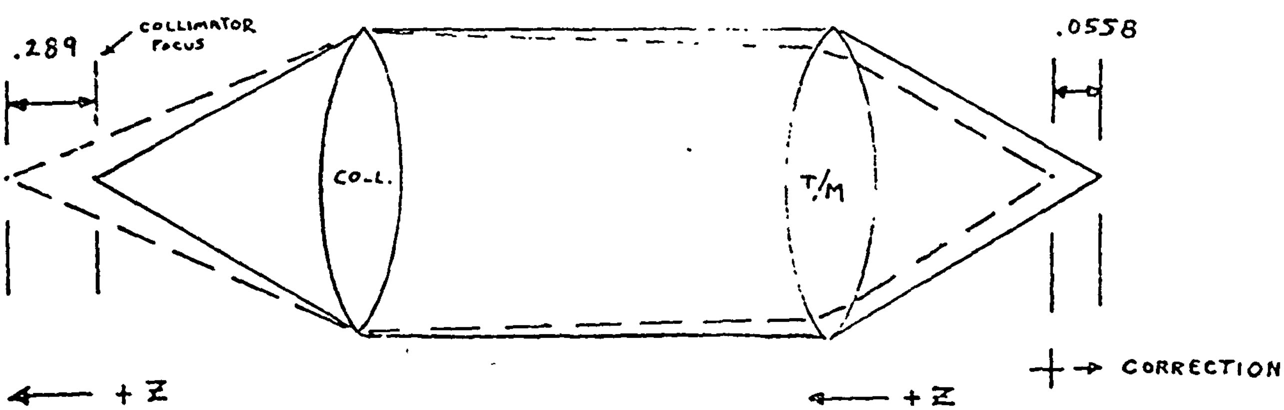
$$\left(\frac{\text{Relay Optics System E.F.L.}}{\text{Collimator E.F.L.}}\right)^2 \times Z \text{ Focus Error at Collimator Focus} =$$

Focus Error at Cold Focal Plane, or:

$$\left(\frac{48}{109.225}\right)^2 \times .289 = .0558 + \Delta Z \text{ Focus Error (Short)}$$

Correction: Shim Increase $(-\Delta Z)$

(PARAXIAL LENS THEORY)



W. J. O'Donnell

W. J. O'Donnell

dz

3.2.4 IA06 TEST

Verification of Telescope Orientation to SMA Pivot Axis

Test Summary: HS236-7926 C.J. Kent

Test Specification: TP32015-506 Scan Mirror to Radiometer Alignment Procedure

Reference Documentation: None

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SANTA BARBARA RESEARCH CENTER
A Subsidiary of Hughes Aircraft Company

INTERNAL MEMORANDUM

TO: J. L. Engel

CC: Optics File
Data Bank (3)
Distribution

DATE: 1 April 1982

REF: 2221-548
HS236-7926

SUBJECT: T.M. Flt. IA06
Test Result Summary

FROM: C. J. Kent & IA06
Test Report Committee

BLDG. B11 MAIL STA. 78
EXT. 6268

References:
1) TP32015-506; Rev. D - Scan Mirror to Radiometer Alignment Test Procedure
2) History Tapes: D03013, D03014, D03015
3) [324,1] DIRECTORY.DIR;43 Master Directory of Data Bases
4) [324,1] DIRECTORY.DIR;45 Master Directory of Data Bases for Coarse Focus Check
5) BTCE #2 Event Log for Period 25 March 1982 through 27 March 1982
6) [322,1] IO6OPV.RED - Reduced Data for Band 1 Detector 9 and Band 4 Detector 9 Open Pattern Value Collects
7) [322,1] IO6OPV.IVF - Intermediate Value File for Open Pattern Value Collects
8) [322,1] IO6OPQ.RED - Reduced Data for Band 1 Detector 9 and Band 4 Detector 9 Opaque Value Collects.
9) [322,1] IO6OPQ.IVF - Intermediate Value File for Opaque Value Collects.
10) [322,1] COVEST.RED - Reduced Data for Index H X Axis Collects Band 4 Detector 9 and Band 1 Detector 9
11) [322,1] CHNCTR.IVF - Intermediate Value File for Index F Collects
12) [322,1] BARYSCN.VID - Video Data Files for Scan Action to Reticle Bar Alignment.
13) TM System Test Log, Book F-1, Pages 043-049

1.0 INTRODUCTION

The following report provides the results of performing the IA06R Test, "Scan Mirror to Radiometer Alignment Test Procedure" on the Thematic Mapper Flight-1 Model (F-1). This test was an integration and alignment level task, performed on the F-1 which was assembled to the level of F-1 assembly, P/N 51065 less sunshade, radiative cooler and adaptor, electronics module, and thermal blankets. Test objectives are detailed in the requirements document HS236-5855 and HS236-5799. The overall objectives included the three following tasks:

1. Image quality measurements were to be made before and after any Telescope Assembly adjustment to allow assessment of system MTF degradation (as a result of permuting primary mirror strain).
2. Alignment of the Prime Focal Plane Array's Along-Scan direction to the Scan Mirror's scanning action was to be accomplished within an error angle of +/- 0.5 mr.
3. Scan Mirror Centration, relative to the system aperture stop (baffle B10) was to be determined by taking measurements at 4 points (in the plane of the mirror), namely margins at +/- x and +/- y.

2.0 TEST REPORT

This report is partitioned according to the three main test objectives.

Focal Plane Alignment to Scan Mirror Action: The procedure for accomplishing focal-plane to scan-mirror alignment involved 3 distinct sub-tests:

1. Orientation of a reference reticle edge parallel to the collimator's y-axis;
2. Orientation of the scan mirror's pivot axis to be perpendicular to the reference reticle edge; and
3. Measurement of the SiFPA-to-edge aspect angle, followed by Optical Assembly rotation, and remeasurement, until the specified angle limit was met.

Attached Figures 2, 3, and 4 illustrate the sensor/edge relationship, the relative motion between sensor and edge, and the error angle of interest for each of the above sub-tests. Figure 2 shows the translation stage moving a misaligned reticle past a stationary detector; Figure 3 shows a detector being translated along the edge (now aligned to the collimator's y-axis) due to scan-mirror motion; and Figure 4 shows an x-direction scan with the reticle edge to reveal differences in x-coordinates of common numbered detectors in Bands 1 and 4.

The residual angles from operations (2) and (3) add algebraically to provide the final alignment error, while the error from (1) provides only a cosine effect on the measurement of the error in (3). It tends to exaggerate the measurement in (3).

The following theta-z errors (TZEn) were measured at the conclusion of each step noted above:

1. TZE1 (Coll. y-axis to reticle edge) = 0. mr
2. TZE2 (reticle edge to scan action) = 0.01 (+/- .02) mr
3. TZE3 (reticle edge to SiFPA Along Scan) = 0.74 (+/- .03) mr

The uncertainty of measurement for these 3 error angles has not been statistically determined; however, various repeat measurements indicate probable uncertainties on the order of the magnitudes reported above. On this basis, the difference: TZE2 - TZE3 = .75 (+/- .05)mr is the final SMA to SiFPA alignment error. The error is greater than the 0.5 mr specification.

TZE2 - TZE3 = TZA = .75 (+/- .05)mr

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T.M. Flt. IA06 Test Result Summary

On a systems level, TZA contributes to the along track band to band registration error. For TZA = 0.75 mrad, this contribution amounts to 0.06 IFOV along track mis-registration between bands 1 and 4. The system level specification is ± 0.2 IFOV. The current value of TZA will not affect our ability to meet this specification.

If the cold focal plane arrays (CFPA's) are aligned to the warm focal plane rather than to the scan direction, the current value of TZA will result in an along track misregistration between bands 1 and 5 of 0.12 IFOV. If the cold focal plane is aligned to the scan direction, T"A will not influence the warm to cold focal plane band to band registration. In either event, the error in TZA is not large enough to affect our ability to meet the systems level specification of less than 0.3 IFOV.

Therefore, no attempt was made to rotate the telescope housing in order to reduce TZA. Waiver W148 has been submitted and accepted in lieu of rotating the telescope housing.

Image Quality Check: Pre-/Post-adjustment measurements in this section were not required since rotation of the telescope housing was not necessary.

Scan Mirror Centration: The Protoflight Model Scan Mirror Substrate is an ellipse 21.10 ± 0.01 inches x 16.30 ±.01inches with a clear aperture extending to within 0.030 inches of the mirror edge. If there is no edge rolloff within the aperture and if centering errors are zero, the mirror margins exceed 0.1 inch for extreme Band 1 and 6 field angles when the Scan Mirror is at its maximum scan angle (38.85 degrees).

The data in Table 3 indicate that edge margins are adequate in the ± X and ± Y directions (see also Figure 5, attached).

Table 3. Scan Mirror Centration

SCAN MIRROR ANGLE (deg)	CLEAR APERTURE RAY HEIGHT(inches)		SCAN MIRROR MARGIN(inches)		
	Y	X	MODELED	MEASURED	ESTIMATED
35.00 (1)	+8.0	0.0	0.672	0.667	---
35.00 (1)	-8.0	0.0	0.608	0.601	---
--- (2)	0.0	+8.0	0.146	0.137	---
--- (2)	0.0	-8.0	0.146	0.132	---
38.58 (3)	+8.0	0.0	0.114	---	0.107
38.62 (4)	-8.0	0.0	0.111	---	0.101

(1) For field angle associated with central LED (-0.0200 deg)
(2) For field angle associated with end of band (0.0195 deg)
(3) For field angle associated with extreme Band 1 (+0.2122 deg)
(4) For field angle associated with extreme Band 6 (-0.2492 deg)

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T.M. Flt. IA06 Test Result Summary

Test Records: All pertinent Video Files, Intermediate Value Files, Command Files, and Data Bases have been saved on the referenced History Tape.

3.0 CONCLUSIONS

The scan mirror-to-PFPA alignment for the Thematic Mapper Flight-1 Model has been accomplished within system level specification.

Scan mirror centration measurements confirm that the mirror has been installed well within tolerances.

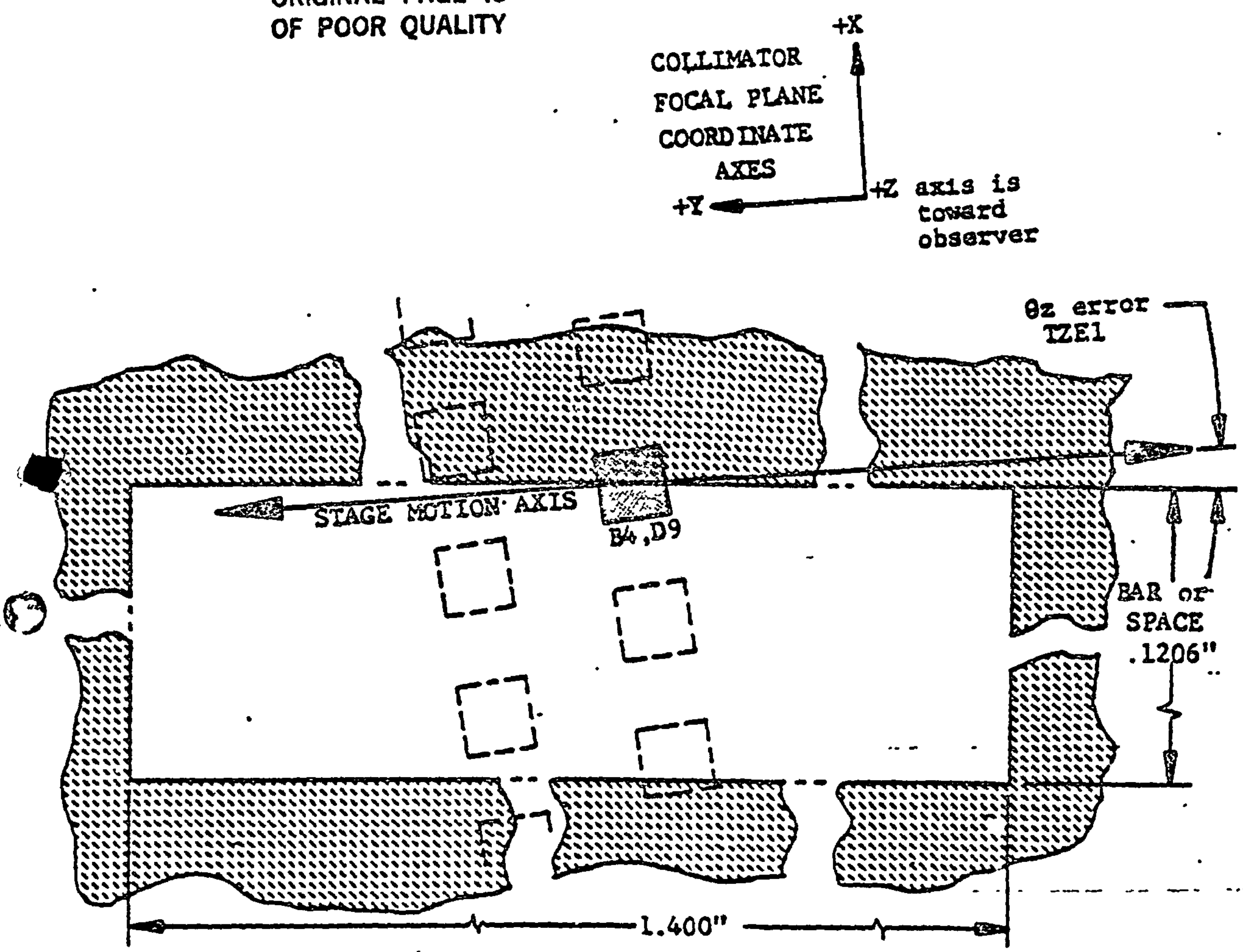
Prepared by: C. J. Kent
C. J. Kent, Test Director

Approvel by: Donald Brandshaft
System Engineering

Release Approval by: [signature]
Manager System Test

dz

Attachments (4)



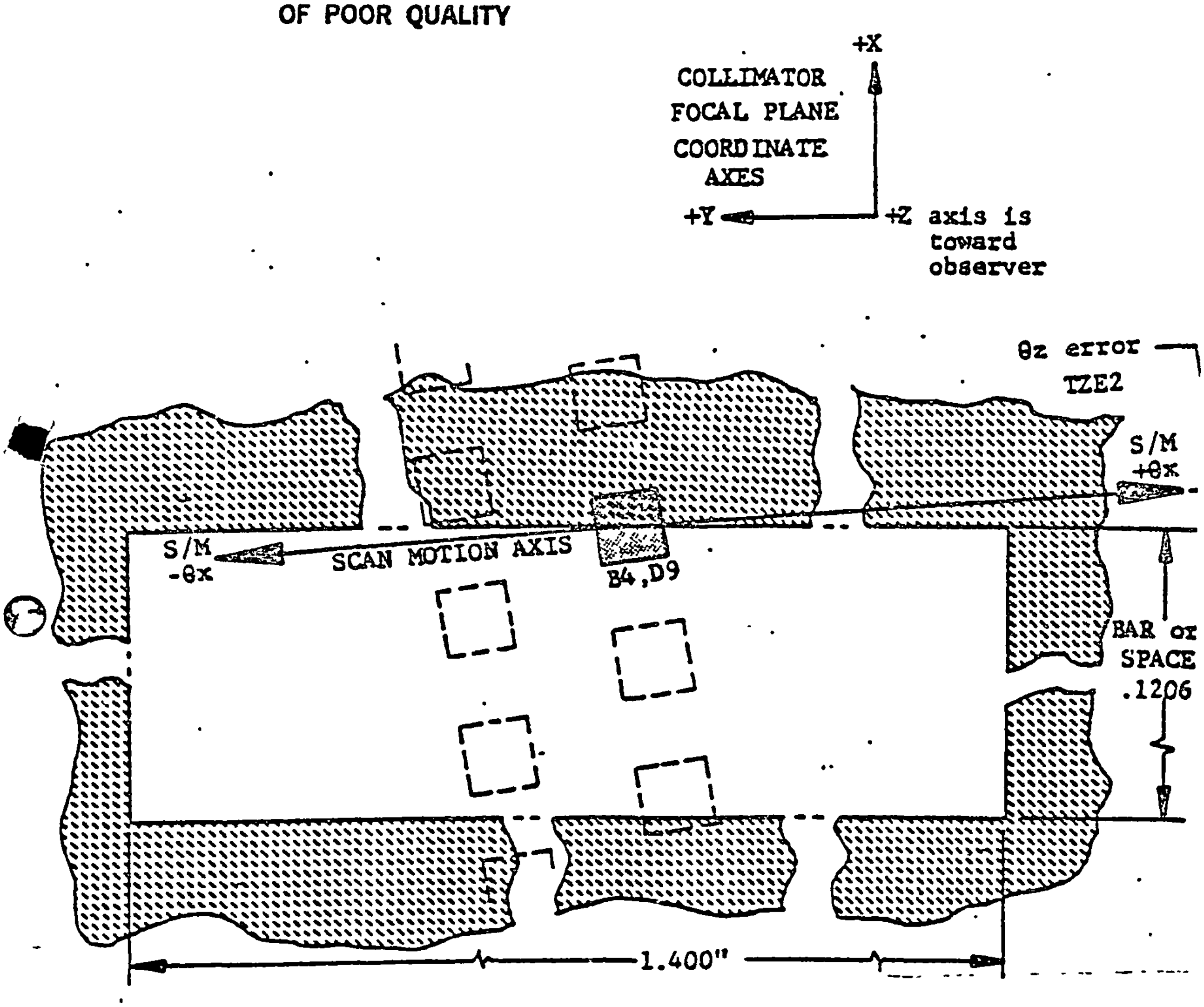
NOT TO SCALE

FIGURE 2

ALIGNING RETICLE EDGE PARALLEL TO Y-AXIS STAGE TRAVEL:

Reticle is translated by stage motion as shown; any change in Band 4, Det.9 output reveals angular error.

IA06 Test Summary (HS236-7926) Attachment B

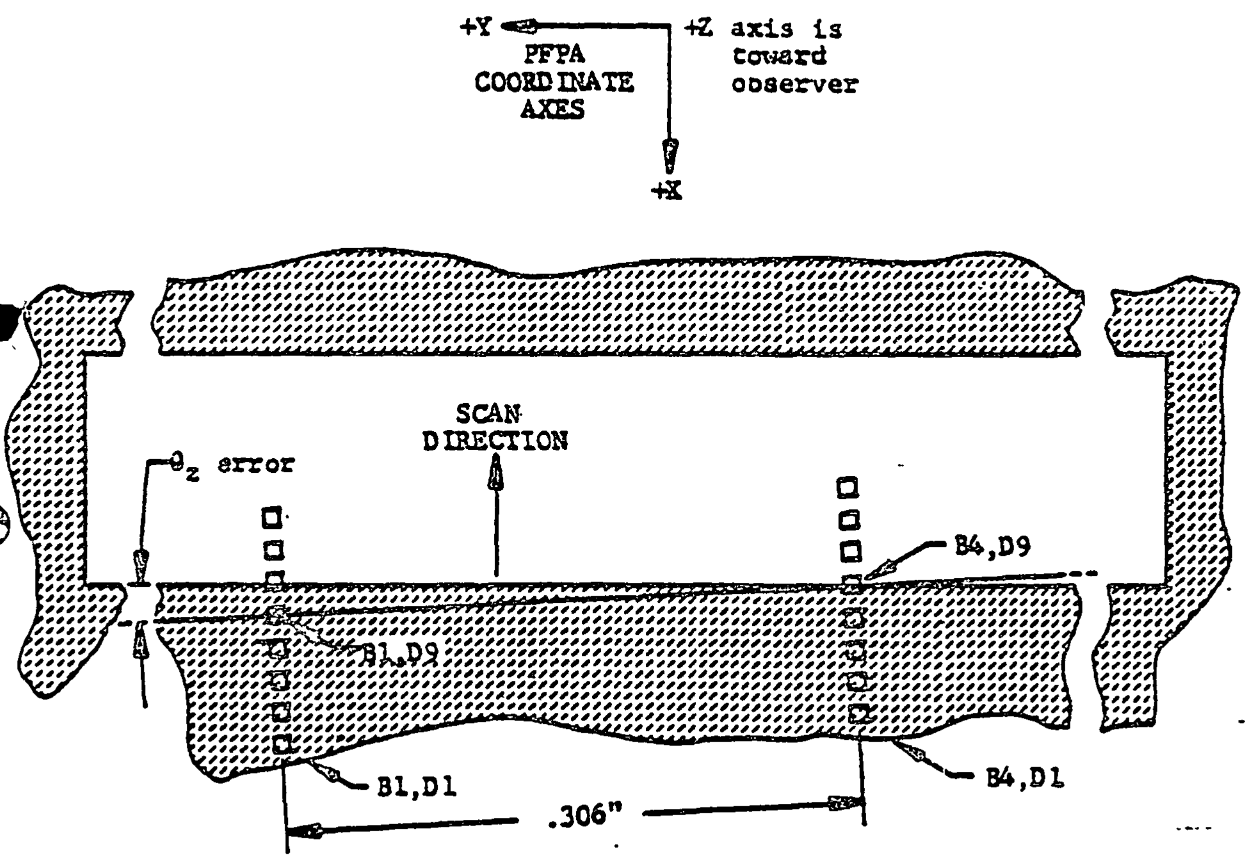


NOT TO SCALE

FIGURE 3

ALIGNING SCAN MIRROR ACTION TO RETICLE EDGE:

As the Scan Mirror rotates thru full forward and reverse scans, relative detector-to-edge motion occurs along the axis shown; any change in detector output reveals angular error.



NOT TO SCALE

FIGURE 4

ALIGNING PFPA'S ALONG-SCAN DIRECTION TO RETICLE EDGE:

The x-axis stage steps the reticle (-X) across common numbered detectors to develop edge traces from which a Δx between detector centers can be determined; the error angle is then TXE3 = $\Delta x/\Delta y$, where Δy is the separation between bands used.

NOTE: USE REVERSE SIDE OF CARD FOR ADDITIONAL ENGINEERING COMME

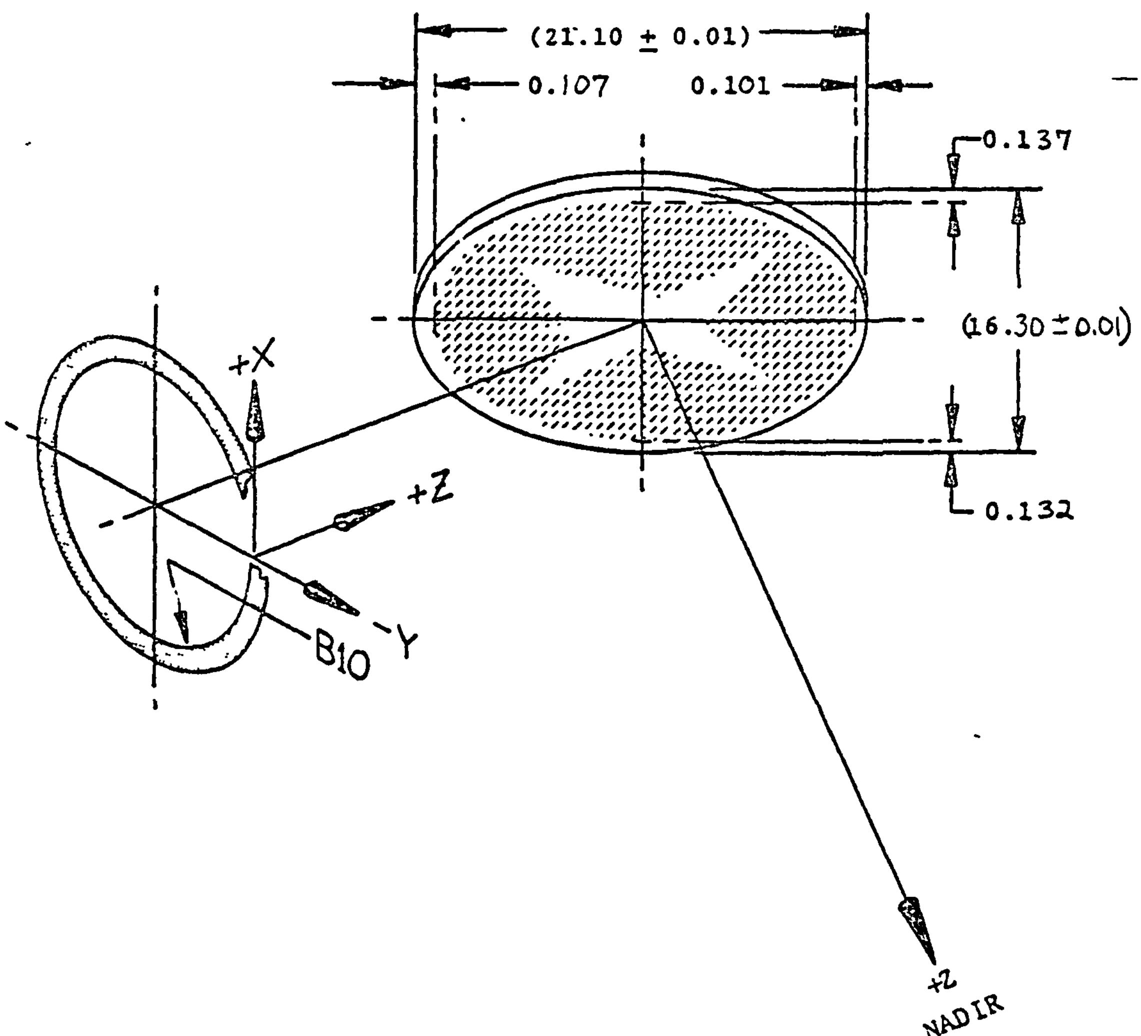


FIGURE 5

SCAN MIRROR CENTRATION MEASUREMENTS